environmental plan

Vision

> Environmental Dimension Objective: The Environmental Plan is designed to create a green, sustainable community that protects and maintains its environmental resources, promotes environmental awareness and responsible resource use/ recycling and promotes increased quality of life throughout the community

The City of Brownsville is one of the most ecologically unique regions in the country. Within the City's approximately 530 square mile Extraterritorial Jurisdiction (ETJ) there are a number of different biological communities exhibiting characteristics from a variety of biomes that can be found within a few hundred miles of the region including: desert, coastal, temperate, sub-tropical and tropical zones. The Lower Rio Grande Valley (LRGV) hosts a varied range of flora and fauna which provide the area with many benefits including millions of dollars in ecotourism trade each year. In Brownsville and the surrounding region, it is estimated that there are over 700 species of vertebrates (86 of which are threatened or endangered), 900 species of beetles, 300 species of butterflies, 33 species of snakes, over 485 species of birds, and 83 species of mammals including two endangered species of wild cat: the Ocelot (Leopardus pardalis) and the Jaguarundi (Puma yagouaroundi).

Also unique to Brownsville and the lower Rio Grande Valley are the Resaca networks that traverse the City. Resacas are old distributaries of the Rio Grande River that once served as a conduit for floodwaters that once plagued this delta region. Although they no longer serve as floodways for the Rio Grande, they still serve several vital functions including: natural habitat for aquatic, avian and terrestrial species, aesthetics, local stormwater detention, temperature moderation, and irrigation water transfer mechanisms for area farming operations. The natural aesthetic beauty of the Resaca systems (often lined with desirable plant species including Ebony, Mesquite, Sabal and Washingtonian Palms, etc.) make them a desirable place to live near as well as a strategic place for cultural and recreational amenities such as parks and tourist centers.

The overall purpose of this environmental plan is three-fold:

1. To establish the vision that the Brownsville citizens have for their community.
2. Identify strengths, weaknesses, opportunities and threats that Brownsville faces in meeting the goals of the vision.
3. To outline both strategic and programmatic strategies that will deliver the vision to the community.

This plan directly addresses the "Sustainability" vision theme that was ranked of high importance at the third public meeting conducted in December of 2008. Additionally, the implementation of this plan would impact many of the other vision themes as indicated in Figure 1.

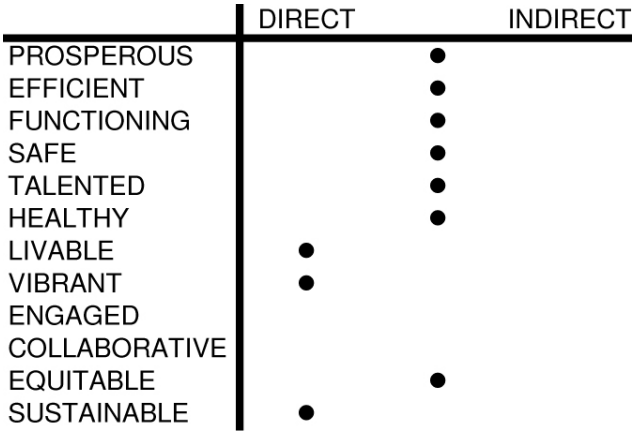

Figure 1. Vision Themes Related to the Environment Element

The overall vision of the Environmental Plan was formulated through a series of consensus building exercises within the subcommittees of the Task Force. While input from all subcommittees of the Task Force was used to develop each plan within the overall comprehensive plan, there are two subcommittees whose discussions were specifically focused on environmental issues throughout the City; the Natural Resources subcommittee and the Solid Waste and Recycling subcommittee. The Natural Resources subcommittee was further broken down into sectors related to air, surface water, groundwater, and soil resources, aquatic habitat, terrestrial habitat and aesthetics. The Solid Waste and Recycling subcommittee focused on the residential, commercial, and industrial sectors of the community.

Through the combined efforts of the Task Force and the consulting team the overlying vision of the Environmental Plan was developed as a series of stated goals and objectives for the community. Overall, 1 environmental dimension objective, 6 sub-dimension objectives, and 51 lower level objectives that were created and used to develop the environmental plan. The 51 lower level objectives were ranked in terms of priority within each of the 8 (Air, Surface Water, Ground Water, Soil, Aquatic Habitat, Terrestrial Habitat, Aesthetics, and Solid Waste/Recycling) sectors. These prioritized objectives were reviewed by the consulting team and consolidated to the following seven objectives. These objectives are not listed in order of priority and should be considered of equal importance.

1. Want sufficient aesthetically pleasing natural resources/parks and a well landscaped, uncluttered visual environment along major thoroughfares, public and open spaces, and commercial establishments throughout the community

2. Want a safe, clean, and sufficient capacity of natural resources (air, water, soil) that meet quality standards consistently and uniformly throughout the community now and in the future.

3. Want to have a sufficient aquatic, terrestrial, and riparian habitat carrying capacity to support suitable and diverse stocks of native flora and fauna consistently and uniformly throughout the community.

4. Want sufficient, reliable and well-maintained solid waste collection, recycling, and disposal service capacity to meet consumer demand and accommodate future growth throughout the community

5. Want the City government fully committed to a successful recycling and sustainability program and open to private and public solutions

6. Want reduction in source volumes and increases in recycled material volumes
    - Want City government to enforce the reduction of packaging waste
    - Want City government to encourage value-added recycling businesses

7. Want a well-informed, engaged public with respect to environmental quality and sustainability

With the main objectives of the Environmental Plan now stated, it is important to identify indicators with which to measure the City's current standing in relation to the stated goals, as well as the City's progress towards achieving each goal in the future through plan implementation.

Key Issue: Lack of a comprehensive environmental data collection, monitoring, and distribution system

With the exception of one major air quality data monitoring station operated by the TCEQ, there is very limited monitoring and management data for the area's natural resources including water quality and quantity, native species habitat and populations, open/green space mapping, and other environmental quality data. Where limited datasets like this do exist, they are often not updated on a consistent basis. Additionally, these datasets are not readily accessible to the public or any interested organization such as local environmental groups, researchers, and even administrative agencies. This lack of a comprehensive environmental data collection, monitoring, and distribution system severely limits the effective management of critical resources. Such a system, if properly developed within a Geographic Systems Information framework, would serve as a vital decision support tool for city managers and administration – permitting sound economic vs. environmental impact decisions to be made with a minimum of effort. The existence of this type of data would also serve as critical decision support data for federally or state funded projects that may negatively impact Brownsville's unique environmental amenities.

Key Issue: Underutilized and environmentally mismanaged Resaca Systems

Resacas (old distributaries or river channels of the Rio Grande River) are perhaps the most unique environmental asset of the City of Brownsville. Unfortunately, this network of waterways has been underutilized and mismanaged from a variety of perspectives including water quality, native habitat preservation, ecotourism potential, storm water management, viewshed management, and their entertainment / cultural center enhancement potential. This mismangement/underutilization of the Resaca systems contributes to lower property values and consequently lower tax dollars for the City in addition to a missed opportunity for economic development through the development of an ecotourism cluster.

There are two key items at the core of this mismanagement – first, a gradual but continual degradation of water quality and shoreline habitat due to unchecked development and sprawl. And second, a profound lack of appreciation and awareness of their potential and importance not only in the environmental arena, but ecotourism, flood protection, and the overall quality of life of Brownsville area residents.

Figure 2. A shopping cart and other waste deposited in a Brownsville Resaca.

At present, several agencies directly or indirectly affect and/or manage this resource including the Public Utility Board, County irrigation and drainage districts, City departments, as well as state agencies such as the Department of Texas Parks and Wildlife. Private, riparian landowners also significantly affect water quality and riparian forest preservation efforts with few management regulations governing water use, shoreline stabilization options, and pesticide/fertilizer usage.

An urgent need exists for the development of a single administrative body to manage Brownsville area resacas, investigate, quantify, and promulgate their varied economic and environmental benefits, and develop sound regulations to preserve this precious resource for the benefit of both current and future citizens.

Key Issue: Low Satisfaction with Existing Recycling Program and Low Recycling Rates

In the past, recycling services were not normally provided by cities across the nation however, over the last decade the national demand for recycling services has greatly increased and many cities now provide recycling services to their residents in the form of drop-off locations and/or curbside pick-up. This increase in demand is largely attributed to the recognition of the importance of recycling in terms of preserving landfill space and sustainable natural resource consumption. Other direct benefits of recycling include reduced consumption rates for natural resources used to produce goods, and increased public awareness of waste volumes.

There is currently no curbside recycling service provided in Brownsville and over 50% of residents are more than 2 miles away from a drop-off location. There are currently about seven recycling drop-off locations located throughout the City as displayed by the yellow dots in Figure 3. The figure displays current drop-off locations as well as one and two-mile range rings around each location. Each of these areas was then analyzed in ArcGIS to identify the number of verified addresses within the respective service areas. The analysis revealed that 22% and 50% of verified addresses in Brownsville are within 1 or 2 miles of a recycling drop-off site respectively. This leaves approximately half of the addresses in Brownsville greater than 2 miles from a recycling site and thus illustrating one of the primary causes behind low resident participation in the program. The lack of a curb-side recycling service also likely contributes to the low recycling rates observed in Brownsville as discussed in Objective 7.

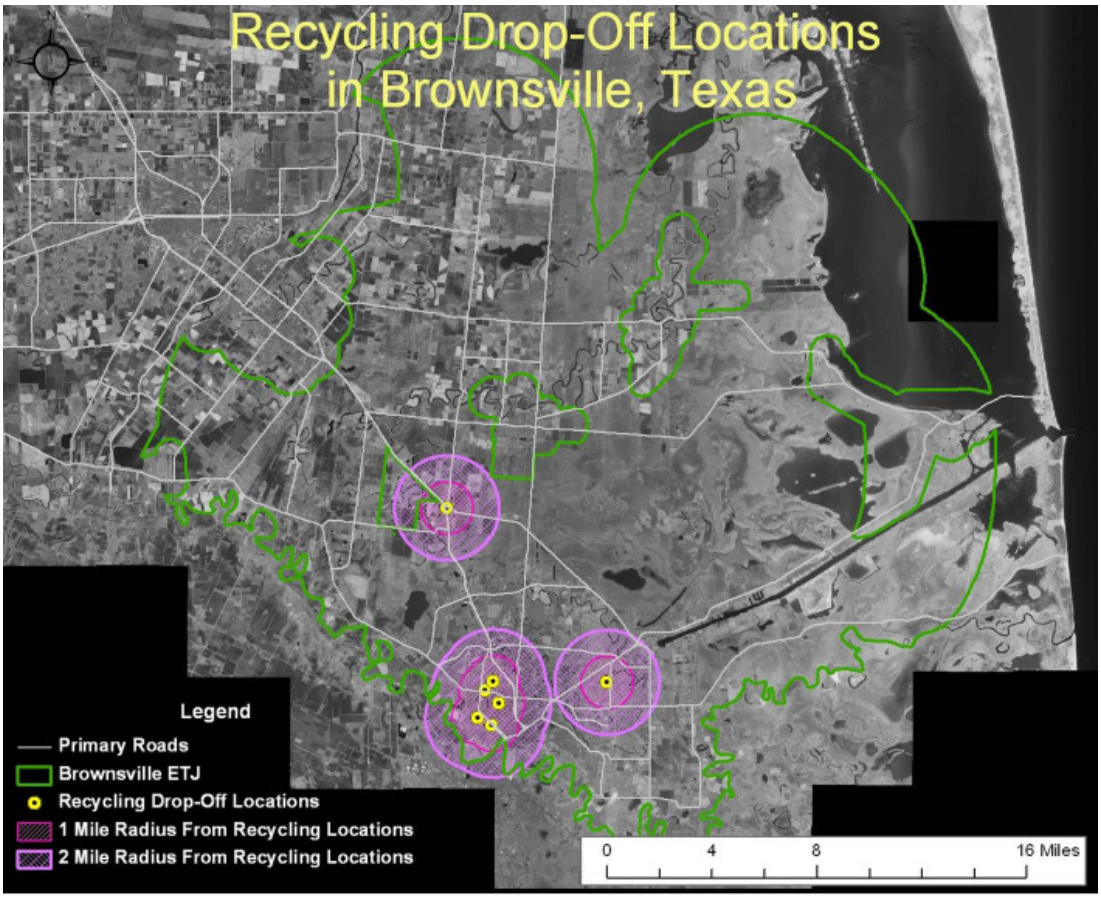

Figure 3. Recycling Drop-off Locations in Brownsville.

Of the over 225 citizens of Brownsville that were surveyed, over 60% responded that they were either "Unsatisfied" or "Very Unsatisfied" with the current recycling program *(Figure 4)*. This is despite an overwhelming 98% who indicated that it was either "Very Important" or "Important" to recycle.

There is currently no educational outreach component associated with the recycling program. Furthermore, knowledge of the program and recycling drop-off locations is largely word of mouth leaving many residents disengaged and unaware of the program. The combination of this issue along with the lack of awareness of the urgent need for recycling results in low participation in the existing recycling program and inhibits it from becoming truly successful.

The current recycling rate in Brownsville is estimated to be less than 1% of the City's total solid waste. This compares to approximately 16% for Houston, TX., 25% for College Station, TX., and 30% for the average of 158 major cities throughout the United States (Figure 5). The most successful City in the U.S. with regards to recycling is Los Angeles at 62%.

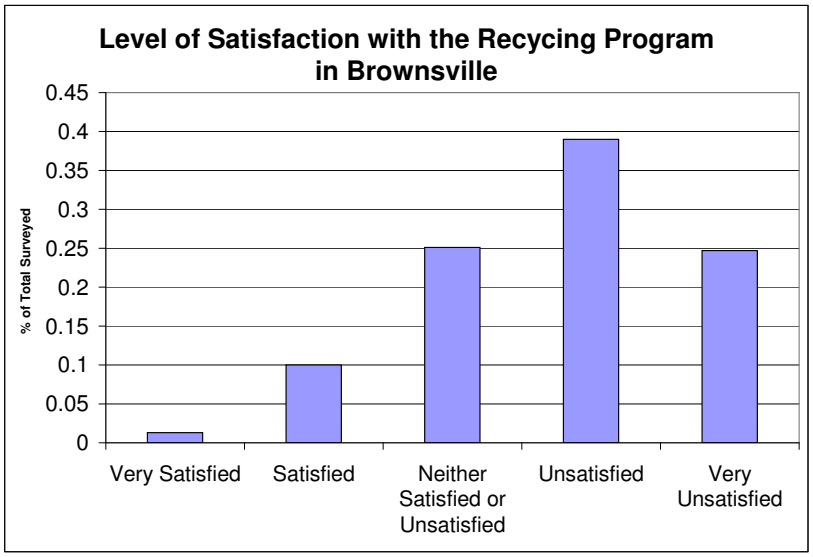

Figure 4. Level of Satisfaction with the Recycling Program in Brownsville.

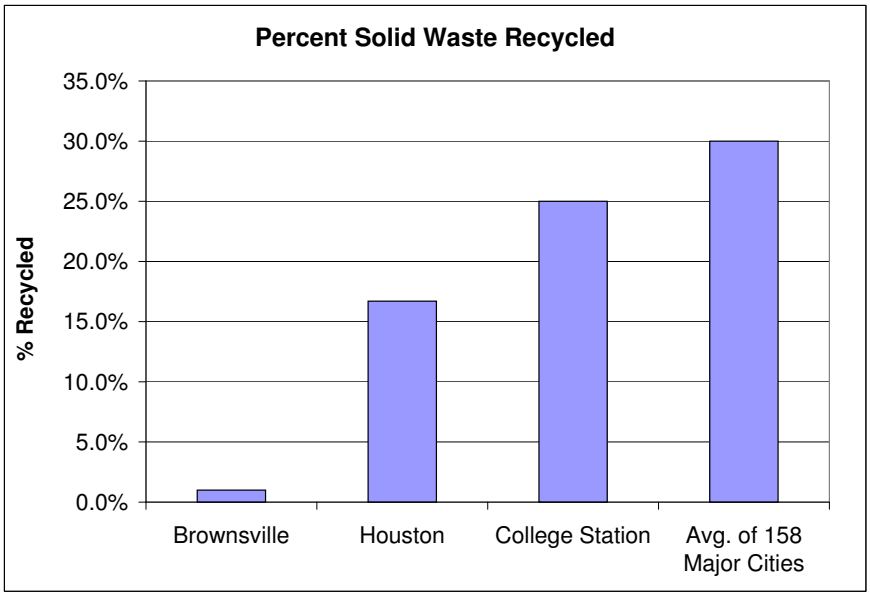

Figure 5. Percent of Solid Waste Recycled Comparison.

Key Issue: Higher than National Average Waste Production Rates

As environmental and sustainability issues continue to become more important, source reduction is another important issue in addition to recycling. Source reduction techniques offer all the benefits of recycling but also includes the benefit of decreased energy requirements and consumption as the demand for unnecessary goods that require energy to develop, manufacture and distribute decreases. It also leads to reduced pollution in commercial parking lots, public properties, and residential neighborhoods.

Brownsville currently has higher than average waste production rates. Waste production rates in the Lower Rio Grande Valley average approximately 5.2 lbs/day/capita vs. 4.4 lbs/day/capita nationally and 3.8 lbs/day/capita in Canada (Figure 6).

Key Issue: Littered Public Thoroughfares and Poor City Image

The aesthetic aspects of a City described in Objective 1, largely influences the public perception of a City's overall image. This also impacts the likelihood of potential developers to invest in the City. Driving into a City and observing littered and/or cluttered thoroughfares, public spaces that are not maintained, etc. fosters a poor City image that has a negative impact on the region's economy, ecotourism trade, and perceived habitability.

Half of the Brownsville residents surveyed have a poor or very poor City image. In a recent survey, over 225 residents of Brownsville were asked to rate their perception of the City's image. While nearly 30% rated the City's image as "Good" almost 50% rated it as "Poor" or "Very Poor" (Figure 7).

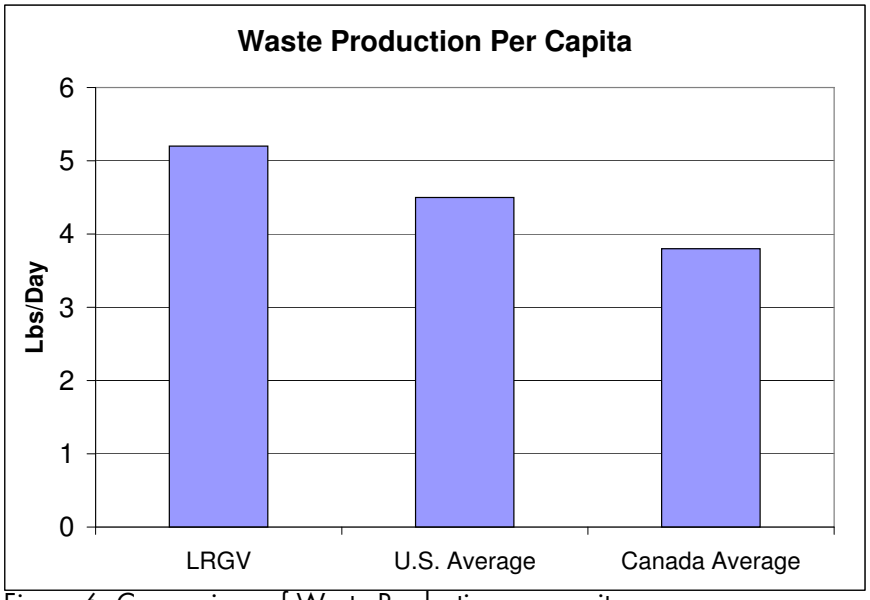

Figure 6. Comparison of Waste Production per capita

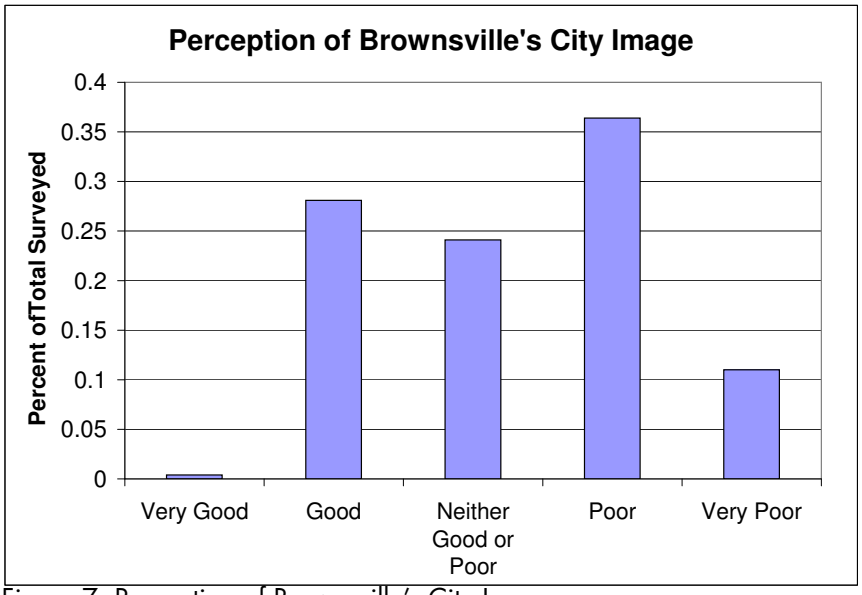

Figure 7. Perception of Brownsville's City Image.

In addition to the presence of litter along public thoroughfares, roadways, and waterways, Brownsville is also blemished by illegal dumpsites. Littering and illegal dumping activity poorly impacts the City's image, degrades the quality of habitat and natural resources, negatively impacts drainage as storm inlets and sewers clog with debris, and leads to more dumping. Strategies to address this issue should focus on litter abatement, maintenance of public spaces and thoroughfares and efforts to curb illegal dumping. The region's consistently higher than average sustained wind speeds further emphasizes the need for a sound litter abatement strategy as solid waste material, particularly plastic bags, can be found miles from their source locations, can lodge in strands of trees (Figure 8), and can even serve as public safety hazards. Additional examples of littered roadways and public spaces may be viewed in Figures 9 - 12 on the following page.

Figure 8. Plastic bags littered along the vegetated swale and stuck in the native mesquite trees along a Brownsville roadway

Figure 9. An illegal dumpsite off of Tandy Rd. in Northwest Brownsville

Figure 11. Litter and debris blocking the inlet of a storm drain

Figure 10. Litter that has collected near a storm drain culvert in a Brownsville drainage ditch

Figure 12. Litter and debris that has collected along a Brownsville drainage ditch

Key Issue: Threat of Growing Population on Air Quality

Currently in Brownsville, air quality is monitored by the Texas Commission on Environmental Quality (TCEQ) at a station (Brownsville C80/ AGP180) located at 344 Porter Drive (EPA site number: 48-061-0006). The air quality monitoring station measures and records levels of Carbon Monoxide, Ozone, PM 10 (Particulate Matter 10 um), and PM 2.5 (Particulate Matter 2.5 um) on an hourly basis, in addition to climatological parameters such as wind speed, temperature, etc. While current pollutant levels are consistently below the 24-hr standards for all measured pollutants, the impact of the growing population and future economic development could influence future trends and result in non-attainment of these federally mandated air quality standards.

While the current air quality in Brownsville is generally good, PM 2.5 levels were reported above moderate levels approximately 59 days in the year 2007 (Figure 13). Moderately elevated PM 2.5 levels (> 15.5 ug / cu m) does not pose an immediate threat to public health but can be associated with minor breathing difficulties for extremely sensitive people such as those with asthma. Furthermore, because PM 2.5 is largely caused by the burning of fossil fuels, Brownsville's growing population and industrial activity could pose a future threat to air quality if not properly considered and planned for now.

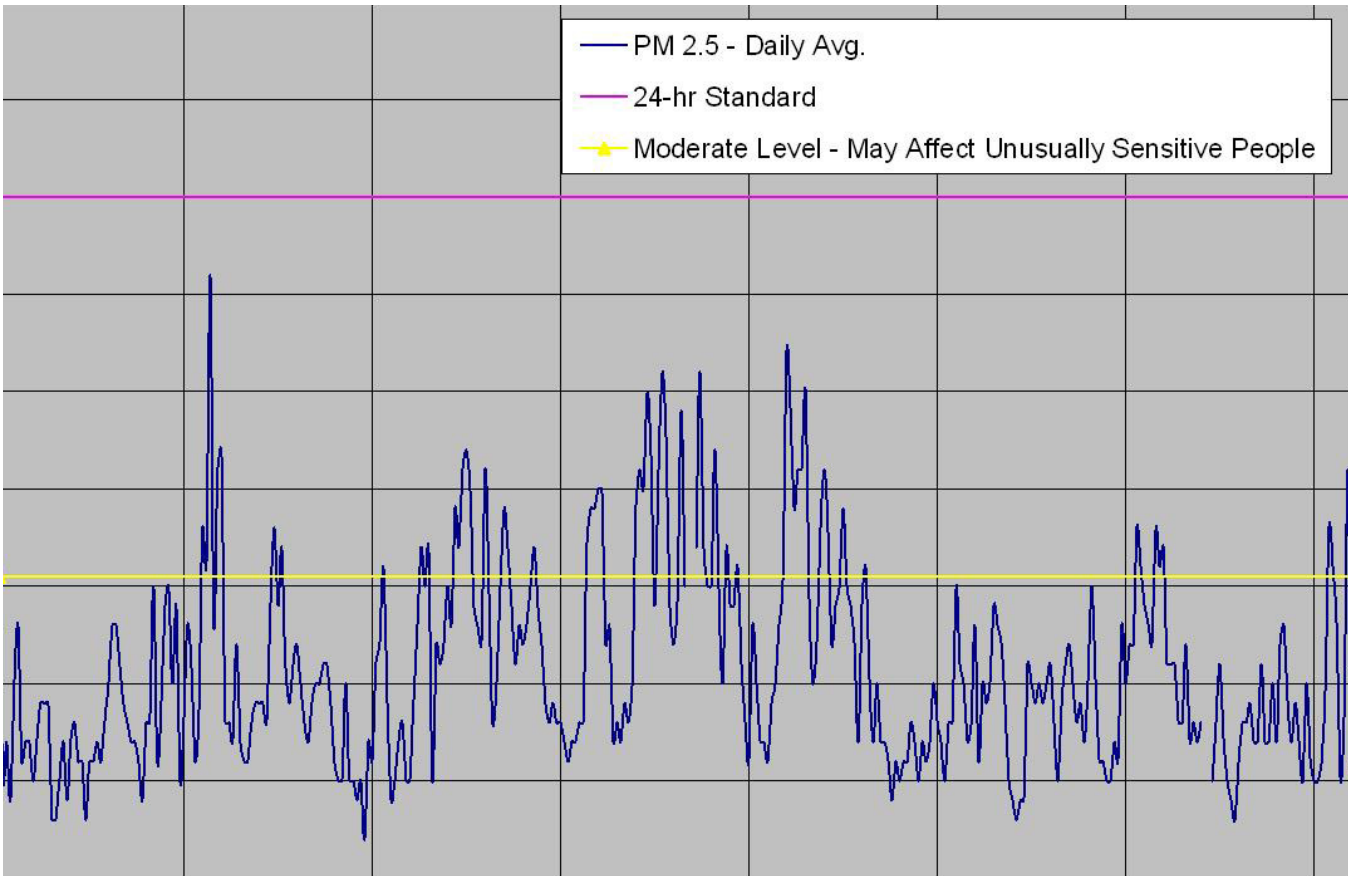

Figure 13. Brownsville's Air Quality.

Key Issue: Significant Loss of Habitat

The ecological diversity that exists in the Lower Rio Grande Valley (LRGV) makes habitat preservation extremely important to the health of the environmental community. It is estimated that there are over 400 species of birds, 700 vertebrate species (86 of which are considered endangered, threatened, or placed on a watch list by the U.S. Department of the Interior, the State of Texas, or the Texas Organization of Endangered Species) as well as a variety of butterflies and insects, some of which cannot be viewed in any other region in the United States. The presence of the endangered Ocelot and Jaguarundi in South Texas is another factor that attracts tourists to the region and illustrates the importance of habitat preservation. In a study conducted by the Houston Advanced Research Center (HARC) in June of 2004 the LRGV was recognized as one of the top birding destinations in North America as well as one of the most ecologically complex and biodiverse.

Habitat in Brownsville is being lost at a rate of approximately 2.5% annually. To assess habitat loss within the Brownsville ETJ over time, land cover data was collected from the Multi-Resolution Land Characteristic/National Land Cover Dataset website (http://www.mrlc.gov/) for 1992 and 2001 (the most recent dataset for the region they have available) and analyzed using ArcGIS 9.2, a geographic information systems (GIS) software. The data for both timeframes may be viewed in Figures 14 and 15. Overall the analysis revealed that between 1992 and 2001, habitat (defined as non-developed, non-cropland) was being lost at a rate of approximately 2.5% annually. If that trend continues, it is estimated that 50% of the habitat area in the Brownsville ETJ will be lost in the next 20 years.

It has been estimated that in 1999, 99% of the U.S. side of the Rio Grande's riparian vegetation had been cleared. In addition, the original 40,000 acres of Sabal Palm Forest in South Texas has been reduced to approximately 40 acres.

Without protective measures these trends of habitat loss will continue as Brownsville grows, negatively impacting the quality of life, threatening endangered and/or protected species of flora and fauna that live in the region and jeopardizing Brownsville's potential to remain and grow as an ecotourism destination. Strategies should address the need to protect important habitat areas while still allowing the area to grow and flourish.

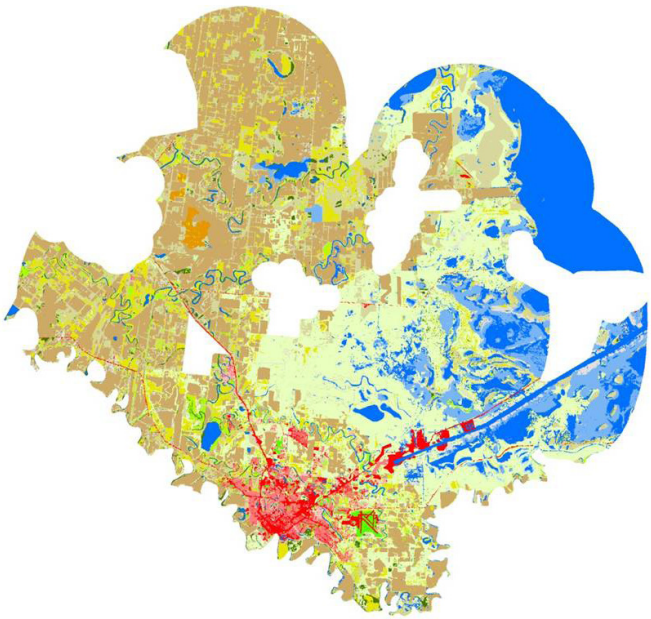

Figure 14. 1992 NLCD Land Use Characterization.

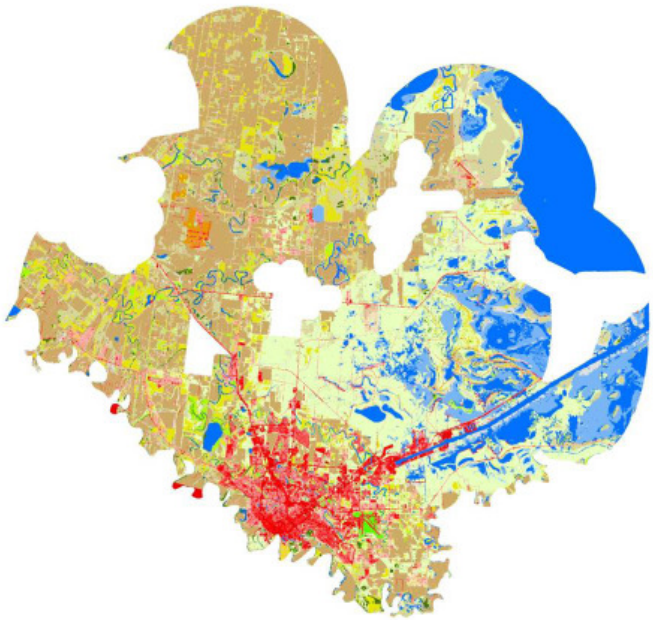

Figure 15. 2001 NLCD Land Use Characterization.

Key Issue: Proliferation of Non-Native, Invasive Species

In addition to overall loss of habitat, proliferation of non-native and/or invasive species in existing natural areas poses a threat to the preservation of native species of plants, trees and shrubs as well as the terrestrial fauna they support by providing them with food and/or shelter. In addition, non-native species sometimes require greater amounts of water and nutrients, depleting loc al resources and out-competing with native, local species native, local species for resources in limited supply.

Figure 16. An Example of mostly native, stabilized riparian corridor along Resaca del Rancho Viejo. (Native species shown include: Ebony, Mesquite, Retama, Sugar Hackberry, as well as the non-invasive but non-native Washingtonian Palms).

Figure 17. Riparian area along Resaca del Rancho Viejo illustrating approximately 50% impedance by two invasive, non-native plant species including Arrondo Cane and Brazilian Pepper Tree.

Figure 18. Riparian area near Resaca del Rancho Viejo that is nearly dominated by invasive, non-native plant species of Arrondo Cane.

Strategic Initiatives

GENERAL ENVIRONMENTAL STRATEGIES

1. Implement a major education and outreach program

Education and outreach efforts should focus on a variety of environmental issues throughout the City including all the key issues addressed in the preceding section. A successful program should focus on partnerships between the City and other local public entities including BISD and UTB/TSC as well as local non-profit groups. Efforts could include, but are not limited to: 1) Development and distribution of information pamphlets (English and Spanish); 2) Development of an environmental website that provides local environmental resource information as well as household strategies for sustainable and environmentally friendly living with an emphasis on source reduction and energy and water efficiency; and, 3) Development of a City-Wide "Don't Mess with Brownsville" campaign.

There are numerous potential sources of external funding for education and outreach programs for which the City could be eligible to apply. Examples include: The EPA's "Environmental Education Grants" program: annual program funding is typically between $2 - $3 million with most funded projects receiving between $15,000 - $25,000. The U.S. International Boundary and Water Commission (IBWC) small project grants for water quality education programs of up to $10,000 through their Texas Clean Rivers Program. Additional funding sources to investigate exist through Texas Parks and Wildlife, Texas Commission for Environmental Quality in addition to a number of other sources.

2. Development of an environmental database and monitoring program

During the data collection step of the existing conditions analysis, one of the main challenges in determining Brownsville's current environmental quality was to find current data sets. With the exception of air quality data (which is monitored and reported by the Texas Commission on Environmental Quality – TCEQ) there is very limited data for local natural resources and the data that does exist is not easily accessible or linked to similar datasets. This strategy would allow for better monitoring of environmental resources and the City's overall environmental quality by providing and managing a web-accessible database containing environmental quality data. Implementation of this strategy would also enable the City to better asses the payback on investments made on environmental projects. The necessary steps in developing this strategy include: 1) formatting the database structure and content; 2) determining where data coverage exists, how it is monitored and how current it is kept; 3) Identifying data gaps; 4) determining how to best obtain data to fill the gaps; and 5) make the data accessible through a maintained, GIS-based website or some other means. To collect data on environmental features that are not formally monitored by a governmental agency, partnerships should be explored with the UTB/TSC, local businesses, citizen groups, etc.

In addition to collecting environmental data, this GIS-based data management system should be developed to collect, manage, and present a wide variety of data throughout the City including, but not limited to: historic buildings, museums, libraries, schools, voting locations, etc. This could be a major asset to the City not only for inventory, and monitoring purposes but also as both an educational resource and a marketing tool. Data such as hotels, restaurants, parks, wildlife refuges, Resaca viewing sites, birding sites, etc. could all be included in the database and uploaded to a web viewer for people researching the area to use to find points of interest throughout the City.

This effort should involve extensive coordination and cooperation with other subcommittee groups with database mapping and management needs, including: equity, civic engagement, and economic. Coordination should also be made with other local and non-local entities who map and/or maintain environmental data including BPUB, USFWS, TPWD, TCEQ, UTB/TSC, etc.

RECYCLING, SOURCE REDUCTION, AND SUSTAINABILITY STRATEGIES

3. Conduct a pilot study for curbside recycling

To meet the demand of improved, convenient recycling services throughout the community it is recommended that a pilot study, including a Cost-Benefit analysis, be conducted. Recycling is important to Brownsville for a variety of reasons including:

- Decreased need for landfills
- Sustainable use of valuable, but limited, natural resources
- Energy savings through the use of recovered materials resulting in lower emissions of smog-forming gases
- Improved air quality through lower demand of trees to produce paper

An example pilot project for Brownsville is outlined below.

Curbside Recycling Pilot Study:

A total of approximately 1200 homes in 3-4 areas of Brownsville should be targeted for a pilot curbside recycling program and study. Suggested target areas and total number of households in each area are shown in Figures 19-22. The purpose of the pilot study is to evaluate the likely participation, the benefits to the community through landfill avoidance (in addition to several other parameters) and the projected cost of running a city-wide program. The pilot program also provides the benefit of starting small to allow for a substantial education and outreach program to improve participation rates and create a larger awareness and demand for recycling services in areas that may be less likely to recycle currently.

Recycling services should utilize single-stream collection techniques in which all recycled materials are collected in a single bin (96-gallon wheeled, covered cart that can be collected using an automated arm on a collection vehicle similar to the way that trash is currently collected throughout the City).

The main advantages of using single-stream

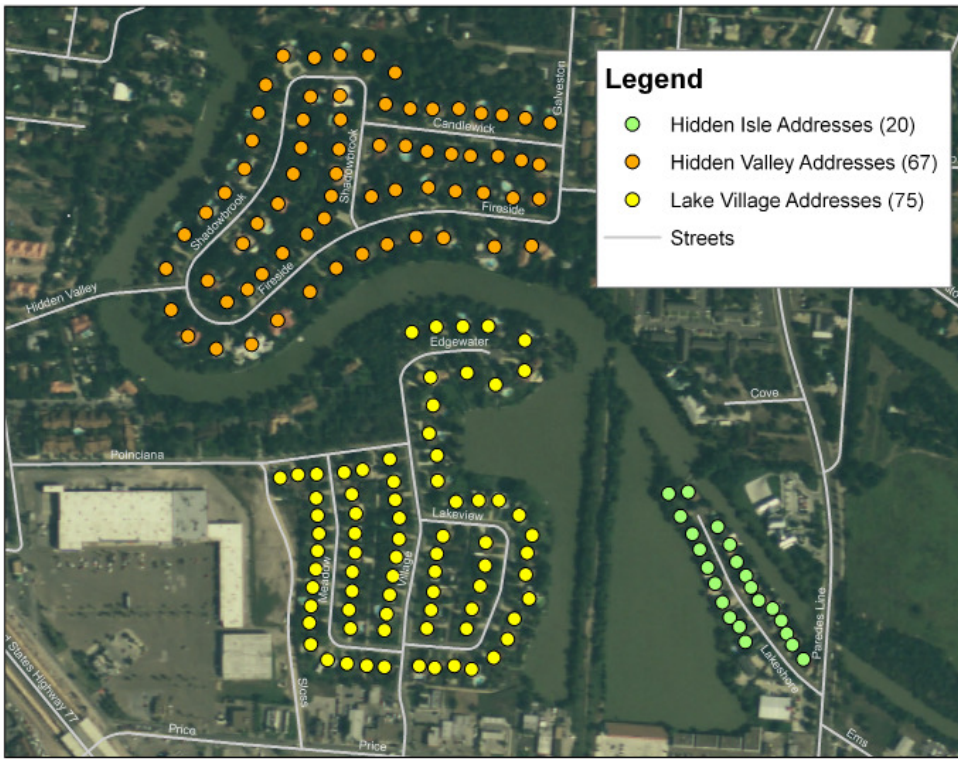

Figure 19. Hidden Isle, Hidden Valley and Lake Village Subdivisions

Figure 20. Villa Hermosa, Part of East Brownsville and Coolidge Subdivisions

Figure 21. Part of Stillman and West Brownsville Subdivisions

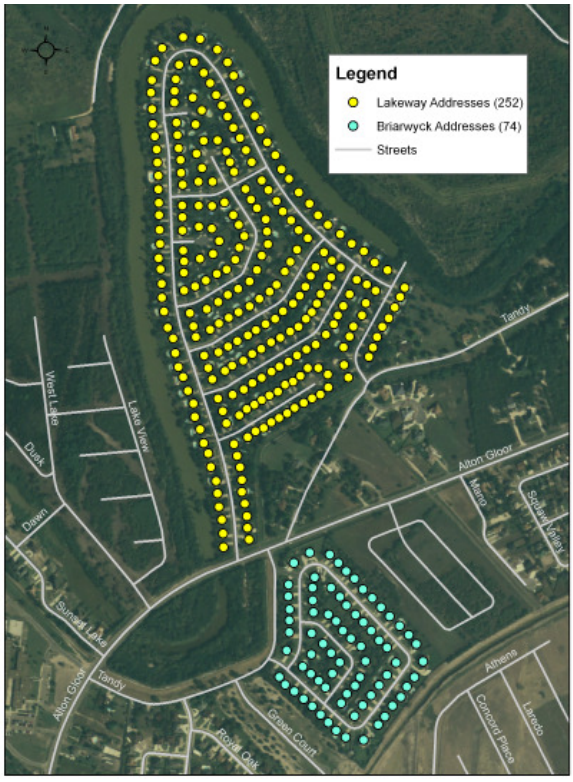

Figure 22. Lakeway and Briarwyck Subdivisions

collection techniques include:

- Added convenience for residents due to increased storage capacity and ability to wheel carts to the curb resulting in higher participation rights;
- Increased storage capacity facilitates higher recycling rates;
- Ability to use a standardized fleet for solid waste recyclables resulting in the need for fewer backup trucks;
- Reduces risk to workers associated with fatigue and exposure to elements resulting in reduced employee turnover, absences, and injury rate;
- Discourages scavenging of more valuable materials;
- Increased efficiency on routes as compared with multi-stream collection due to increased speed of collection;
- Decreased landfill costs; and
- Decreased emissions as compared with multi-stream collection due to reduced time spent idling while materials are sorted at the curb.

The pilot curbside study would collect plastics, aluminum and tin cans, cardboard and paper (including newspaper, office paper, books, magazines, shredded paper and phone books). While the public and task force meetings revealed a desire to include glass recycling opportunities, it is not recommended for the pilot study due to the added difficulties presented with glass recycling. Specifically, problems often sited with single-stream recycling programs that incorporate glass, is the contamination of material due to glass particles breaking into small sizes that cannot be easily filtered from other materials. This is especially problematic for paper recycling. In the future, curbside glass recycling could be re-examined using dual stream collection techniques in which glass is collected in separate containers. While it would be possible to immediately begin with a dual-stream collection system that includes glass, it is believed that the benefit of starting simple and maximizing participation potential through a less complex and time-intensive system outweighs the benefit of providing curbside glass recycling. Instead, glass recycling will be addressed separately in Strategy 5.

A key element of the pilot study is the education and outreach component. This component of the project should focus on educating the targeted pilot areas as to the importance of recycling, proper use of the distributed recycling bins, appropriate materials to include in the bins, and when the materials will be picked up. Additionaly, the concept of source reduction should also be addressed to further minimize the amount of material being deposited in the lanfill. There have been numerous studies that illustrate the importance of education programs in conjunction with recycling. Compliant participation and overall efficiency are significantly increased with every additional dollar spent on education and outreach. Curbside Value Partnerships, an organization dedicated to assisting communities with improving recycling programs, recommends a minimum of $1 / household for education and outreach but reports that higher amounts in the range of $3 - $4 / household have proven to be much more effective.

The costs associated with implementing a plan are dependent on the overall compliant participation

and efficiency in which goods are collected. Recycling rates in Brownsville are currently very low. Offering curbside service could greatly improve recycling rates in Brownsville but without actually conducting a pilot study, there is no good way to estimate participation. Surveys tend to be highly ineffective in this regard due to a much higher tendency to report participation than reality. Despite this difficulty, a range of anticipated costs associated with implementing city-wide, curbside recycling is provided in Tables 1 and 2 on the following pages.

Tables 1 and 2 illustrate approximate Annual Recycling Program Costs and Benefits per Household for different recycling rates ranging from 0% (no recycling) to a maximum of 30% (30% of solid waste stream recycled). Costs and benefits were calculated assuming 50,000 households (data rounded from U.S. Census Bureau) and a waste stream generation rate of 5.6 tons per year per household (based on estimates from the Brownsville landfill). Estimated costs include collection, sorting, sales, administration, and education expenditures. A variable, as of yet undetermined, non-compliant participation cost is also included. This cost will be estimated after implementation and assessment of the pilot project. This analysis assumes that all services will be bid out to a third party as opposed to the City

Estimated benefits that can be readily quantified include avoided landfill costs and the money reacovered from the sale of recycled materials. Table 1 and 2 differ by varying the Total Program Cost / Household estimate and the Recycled Material Sale Price as highlighted in yellow. Table 1 keeps the Program Cost fixed at the high end price of $56.00/household while varying the Recycled Material Sale price from a high end of $5.00/ton to a low end of $0.00/ton. Table 2 keeps the Program Cost fixed at $36.00/household (from $56.00) and again varys the Recycled Material Sale price from $5.00/ton to $0.00/ton. These ranges are necessary due to the high variability of program costs and recycled material sale price over time and from region to region.

Tables 1 and 2 also show the resulting monthly fee / household required to offset the unrecouped program costs. It can be seen that the sale of recycled materials and benefits of landfill avoidance do not completely cover total annual program costs. However, as the recycling rate increases, the required monthly fee decreases. The "best case" scenario in Tables 1 and 2 is the lowest program cost of $36.00/household and a maximum sale price of $5.00/ton. In this scenario it is estimated that approximately $0.69 per household per month would be required to cover the costs of the program. For the "worst case" scenario, with a program cost of $56.00/household and a sale price of $0.00/ton, the required monthly fee per household is approximately $4.67. This range of fees illustrates a manageable cost for implementing a recycling program to meet the City demand and justifies the initiation of the pilot study to further examine the cost and logistics of implementing city-wide. Furthermore, the pilot study would help reveal the best way to fund the project whether the fee is designated on a volunteer basis for those wishing to have curbside recycling or if it is distributed evenly to all residents regardless of their participation with the program.

Extrapolating the results of this analysis yields an approximate breakeven point of about 35-40% recycling rates. In other words, given these cost and benefit figures, the City would have to divert and sell 35-40% of its household solid waste stream as recycled material. The "worst case" scenario of the combining the highest program cost of $56.00/household with a no-demand market for recyclable material (meaning a sale price of $0.00 / ton), would result in the highest cost per household fee. Extrapolating the results of this analysis yields an approximate breakeven participation and recycling rate of nearly 85%.

Compliant participation can also be estimated by the use of a pilot study. Compliant participation rates often differ from participation rates due to the fact that unrecyclable goods are often deposited in recycling bins either unintentionally or due to confusion over which goods are actually recyclable. Compliant participation has been identified as one of the most important parameters

	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
(Tons/HH/Yr)	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 48.00	$ 48.00	$ 48.00	$ 48.00
Administrative	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 56.00**	**$ 56.00**	**$ 56.00**	**$ 56.00**
Total Recycling Program Cost/Yr	$ 2,800,000	$ 2,800,000	$ 2,800,000	$ 2,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	**$ 5**	**$ 5**	**$ 5**	**$ 5**
Annual Recycled Material Sales	$ -	$ 140,940	$ 281,880	$ 422,820
Total Recycling Program Benefits/Yr	-	484,094	927,998	1,388,978
Net Benefits	(2,800,000)	(2,315,906)	(1,872,002)	(1,411,022)
Required Monthly Fee / Household	$ 4.67	$ 3.86	$ 3.12	$ 2.35
	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
Baseline Waste Production Rate (Tons/HH/Yr)	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 48.00	$ 48.00	$ 48.00	$ 48.00
Administrative	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 56.00**	**$ 56.00**	**$ 56.00**	**$ 56.00**
Total Recycling Program Cost/Yr	$ 2,800,000	$ 2,800,000	$ 2,800,000	$ 2,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	**$ 3**	**$ 3**	**$ 3**	**$ 3**
Annual Recycled Material Sales	$ -	$ 84,564	$ 169,128	$ 253,692
Total Recycling Program Benefits/Yr	-	427,718	815,246	1,219,850
Net Benefits	(2,800,000)	(2,372,282)	(1,984,754)	(1,580,150)
Required Monthly Fee / Household	$ 4.67	$ 3.95	$ 3.31	$ 2.63
	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
Baseline Waste Production Rate	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 48.00	$ 48.00	$ 48.00	$ 48.00
Administrative	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 56.00**	**$ 56.00**	**$ 56.00**	**$ 56.00**
Total Recycling Program Cost/Yr	$ 2,800,000	$ 2,800,000	$ 2,800,000	$ 2,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	**$ -**	**$ -**	**$ -**	**$ -**
Annual Recycled Material Sales	$ -	$ -	$ -	$ -
Total Recycling Program Benefits/Yr	-	343,154	646,118	966,158
Net Benefits	(2,800,000)	(2,456,846)	(2,153,882)	(1,833,842)
Required Monthly Fee / Household	$ 4.67	$ 4.09	$ 3.59	$ 3.06

	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
Baseline Waste Production Rate (Tons/HH/Yr)	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Administrative	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 36.00**	**$ 36.00**	**$ 36.00**	**$ 36.00**
Total Recycling Program Cost/Yr	$ 1,800,000	$ 1,800,000	$ 1,800,000	$ 1,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	**$ 5**	**$ 5**	**$ 5**	**$ 5**
Annual Recycled Material Sales	$ -	$ 140,940	$ 281,880	$ 422,820
Total Recycling Program Benefits/Yr	-	484,094	927,998	1,388,978
Net Benefits	(1,800,000)	(1,315,906)	(872,002)	(411,022)
Required Monthly Fee / Household	$ 3.00	$ 2.19	$ 1.45	$ 0.69

	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
Baseline Waste Production Rate (Tons/HH/Yr)	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Administrative	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 36.00**	**$ 36.00**	**$ 36.00**	**$ 36.00**
Total Recycling Program Cost/Yr	$ 1,800,000	$ 1,800,000	$ 1,800,000	$ 1,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	**$ 3**	**$ 3**	**$ 3**	**$ 3**
Annual Recycled Material Sales	$ -	$ 84,564	$ 169,128	$ 253,692
Total Recycling Program Benefits/Yr	-	427,718	815,246	1,219,850
Net Benefits	(1,800,000)	(1,372,282)	(984,754)	(580,150)
Required Monthly Fee / Household	$ 3.00	$ 2.29	$ 1.64	$ 0.97

	% RECYCLED			
	0%	10%	20%	30%
Households (HH)	50,000	50,000	50,000	50,000
Baseline Waste Production Rate (Tons/HH/Yr)	5.6	5.6	5.6	5.6
Annual Recycling Program Cost/HH				
Collection/Sorting/Sales	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Administrative	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Education	$ 3.00	$ 3.00	$ 3.00	$ 3.00
Non-compliant participation cost	TBD	TBD	TBD	TBD
Total Program Cost/HH	**$ 36.00**	**$ 36.00**	**$ 36.00**	**$ 36.00**
Total Recycling Program Cost/Yr	$ 1,800,000	$ 1,800,000	$ 1,800,000	$ 1,800,000
Annual Recycling Program Benefits				
Annual Avoided Landfill Costs	$ -	$ 343,154	$ 646,118	$ 966,158
Recycled Material Sale Price ($/ton)	$ -	$ -	$ -	$ -
Annual Recycled Material Sales	$ -	$ -	$ -	$ -
Total Recycling Program Benefits/Yr	-	343,154	646,118	966,158
Net Benefits	(1,800,000)	(1,456,846)	(1,153,882)	(833,842)
Required Monthly Fee / Household	$ 3.00	$ 2.43	$ 1.92	$ 1.39

in a successful recycling program. To clarify further, consider the example of a neighborhood with 100 households. It would be possible for this neighborhood to have a participation rate of 40% and a compliant participation rate of 25%. In this case, 40 of the 100 homes would be participating, but only 25 of those participating homes had sufficiently low contamination rates in their recycling bins to be considered recyclable.

Assuming the same per household costs described in Tables 1 and 2 for the pilot study as was used in the Citywide analysis, it is estimated that the pilot study would cost between $50,000 - $78,000 for collection, sorting, etc. and an additional $5,000 - $10,000 to track and evaluate data generated from the study. The pilot study should be evaluated for 12-18 months.

4. Incorporate glass recycling into Brownsville's recycling program

This strategy involves providing an opportunity for glass recycling at the current drop-off center on Elizabeth Street. Glass recycling should be included in all future contracts for recycling services provided to the City and carefully monitored to determine an overall monthly recycle rate. This information will be used to determine the feasibility of purchasing a glass crusher to use for beach sand renourishment at South Padre Island. Currently there are efforts throughout the country to examine the use of crushed, recycled glass for sand renourishment in coastal towns plagued by erosion. One such test bed for this project is in Broward County, Florida. Contingent on the successful use of recycled, crushed glass in other communities, the possibility exists to work with the Town of South Padre Island, the Town of Port Isabel, BISD, and UTB/TSC to use similar techniques at the beaches of South Texas. Careful monitoring of recycled glass volumes in Brownsville would be the first necessary step in evaluating the feasibility of such a project to determine if there is an adequate tonnage of glass recycled to make such a program cost-effective. In parallel with this step, the City should support research efforts at UTB/TSC to study glass particle compatibility with sand at South Padre Island and evaluate the benefit-cost relationship relative to other beach renourishment techniques.

5. Mandate recycling and source reduction plans for all City Departments

All City departments would be mandated to develop and implement a recycling and source reduction plan. Elements of the plan should include, but are not limited to, paper, plastic, and aluminum recycling; computer, ink cartridge, battery, and other recyclable office supply equipment recycling; encouraging double sided printing whenever possible and only printing things like emails when necessary, etc. All City departments would be responsible for implementing their own plan based on targets set by the environmental subcommittee of the planning implementation board described in the implementation section of this plan.

6. Implement energy efficiency improvements at City owned buildings

One of the strengths of the downtown area of Brownsville is the number of older, architecturally interesting buildings, some of which are historic. While the use of these buildings as municipal offices and/or facilities enhances the beauty and preservation of the historic downtown, many of them are likely not retrofitted with energy efficiency improvements causing significant energy (and dollar) losses through leakages of cooled air to the outside especially during the warm summer months. To improve the overall energy efficiency of these buildings which in addition to providing an environmental benefit to the City also lowers monthly energy costs, a variety of improvements could be implemented. Such improvements include replacing lighting systems and light bulbs with higher efficiency models, installing ceiling fans and programmable AC thermostats, installing sealants and weather-stripping around doors and windows, replacing old, single pane windows with newer varieties that provide increased insulation, installing better or additional insulation in attic spaces, and installing solar screens that block out 90-90% of solar radiation. While the costs associated with implementing these improvements vary quite a bit depending on the specific actions put into place,

a rough estimate would be anywhere between $10-$50 per sq ft of building space to implement necessary improvements. To properly determine which strategies should be implemented the building in which improvements are going to be made should be analyzed in terms of current energy consumption and sources of loss or inefficiency in the building. From there, specific strategies can be determined and implemented.

A second component of this project is to track the effectiveness of the completed improvements to use as an educational example to residents and businesses. Indicators that should be tracked are presented in the Implementation Section at the end of the Environmental Plan Element Section. These values could be used for public presentation through a webpage or some other means, to promote energy efficiency strategies in homes and business and to present potential cost savings upon implementing such strategies.

7. Develop incentives for businesses to develop environmental sustainability plans

In addition to mandating environmental sustainability measures throughout City departments and municipal buildings as described in Strategies 8 and 9, an incentive should be provided for local businesses to implement similar strategies.

8. Develop a screening and selection process for new City fleet purchases to maximize fuel efficiency and develop and implement routine maintenance inspections.

This strategy involves implementing a screening and selection process for all new City fleet purchases that aims to maximize fuel efficiency as much as possible except when it would compromise the needed function of a given vehicle. After purchase routine maintenance activities should be scheduled at regular intervals to increase the life of the vehicle, repair any defects that may lead to increased emissions or leaking of automotive fluids, and ensure that the vehicle is running as efficiently as possible.

9. Develop a mechanism such as a plastic bag tax, to reduce plastic bag usage at stores

Due to the increasing problem of plastic bag litter strewn throughout the City, along with the environmental impact of plastic bag production, distribution, and breakdown, a mechanism to diminish the use of such bags is needed. The recommended approach would be a phased program beginning with an educational component and a voucher program to purchase reusable bags for the first year. Following the first year, a tax would be implemented (suggested tax of 5 cents/bag) for every plastic bag used. Money collected from the tax would be placed in a "Green Fund" to help finance future environmental projects.

LANDUSE AND RESACA MANAGEMENT STRATEGIES

10. Water reclamation and nonpotable reuse - Investigate the use of treated wastewater to replenish surface water reserves such as Resacas.

The PUB 2010 Water and Wastewater Management Plan estimates that the average combined discharge from the No. 1 and No. 2 Brownsville Wastewater Treatment Plants will be approximately 13.9 million gallons per day (MGD). It is recommended that the City investigate strategies for replenishing appropriate portions of the Resaca systems with varying degrees of additional treatment. Ideal candidates in the Resaca system are those "Bancos" or oxbow lakes that are near the Rio Grande River and are within the boundaries of park preserves. These water bodies are typically more isolated and not used for irrigation of public access lands nor used for direct irrigation of crops and as such, will minimize the additional level of treatment required prior to reuse. The enhancement of Brownsville's wastewater treatment plants with additional filtration systems and/or enhanced disinfection processes may make it possible to

reclaim water for use in other portions of the Resaca system and/or irrigation of public lands such as golf courses, parks, greenways, etc. Additional information on this topic is available in the "Guidelines for Water Reuse" published by the U.S. Environmental Protection Agency, Municipal Support Division, Office of Wastewater Management, Washington, D.C.

11. Implement smart growth principles for future land use planning that preserve natural resources and restore the integrity of the Brownsville's Resaca Systems

The following sections discuss specific key environmental features, and practices that should be implemented to reduce negative environmental impact and preserve resources within each landuse module.

Nodes

General Recommendations

Nodes within the landuse plan are generally located at key intersections and are characterized by higher densities of commercial (and other) development depending on the specific type of node (i.e. Downtown, Regional, etc.). These regions provide an opportunity for a number of strategies to alleviate the environmental impacts of development, lessen drainage issues, improve the aesthetic quality of the community and provide direct cost-savings in terms of water and electricity consumption. Examples of strategies that should be recommended and/or mandated include: use of rooftop rain gardens, small scale renewable energy installations (i.e. rooftop wind turbines, solar panels), incentives for higher-efficiency cooling systems, use of native plants in streetscape, parking lots, etc., use of high-efficiency street lighting alternatives, and incentives for building owners who comply with set energy efficiency standards.

Resaca Management

In nodes that intersect Resaca systems, particularly the Downtown Node, special consideration should be made as to appropriate uses of land that border these resources. Financial incentives should be made to encourage responsible and appropriate development along these corridors to minimize environmental impact and maintain the continuity as the Resaca runs between various Districts, Corridors and Nodes. Development in these regions should have a plan to incorporate native trees and grasses, provide adequate vegetated buffer widths between paved areas and Resaca frontage, and to incorporate walking trails, decking, and access points that enhance and provide access to these unique natural resources.

Corridors

General Recommendations

Corridors represent transportation routes in, out, and around the City. They are characterized by high percentages of paved, impervious area that collect oil, and other automotive fluids from leaking cars as well as other various types of pollutants and litter. Non-point source pollution from car exhaust is another concern, especially in high-traffic areas. To minimize the negative environmental impacts of these issues associated with corridors, strategies should be implemented that aim to minimize non-point source air pollution, non-point source water pollution caused by stormwater runoff from roadways, and litter. Strategies that prevent increased runoff rates due to elevated % impervious cover should also be implemented. Wherever possible, corridors should be lined with native trees and shrubbery. This will help offset the impact of increased CO2 emissions from car exhaust, provide continuity of habitat corridors as districts, nodes and corridors intersect, and provide a valuable visual amenity to the City. Litter abatement in corridors and in all landuse module areas should be addressed through education and outreach strategies. Additionally, City ordinances requiring lids and regular emptying of outdoor garbage receptacles, and greater enforcement of laws that penalize residents and/or businesses that are caught

littering should be enacted. Penalties for littering should include a fine and mandatory community service.

Resaca Management

To minimize the impact of polluted stormwater entering Resaca systems, vegetated swales of at least 30 ft should be maintained where parking lots and streets cross, or run adjacent to resacas. The City should also investigate the use of oil-grit separators and/or grit chambers in catch basins along corridors to minimize the pollutants that drain from the secondary stormwater system into Resacas. Installation of these systems needs to be accompanied by a regular maintenance plan to ensure effectiveness. In addition to improving water quality in these systems, these types of inlet structures could be incorporated into the City's stormwater management plan (SWMP) and help the City to comply with Phase II Texas Pollutant Discharge Elimination Standards (TPDES).

Wherever possible, public access to Resacas should be provided within corridor modules and walkways and observation decks should be encouraged.

Downtown Riverside District

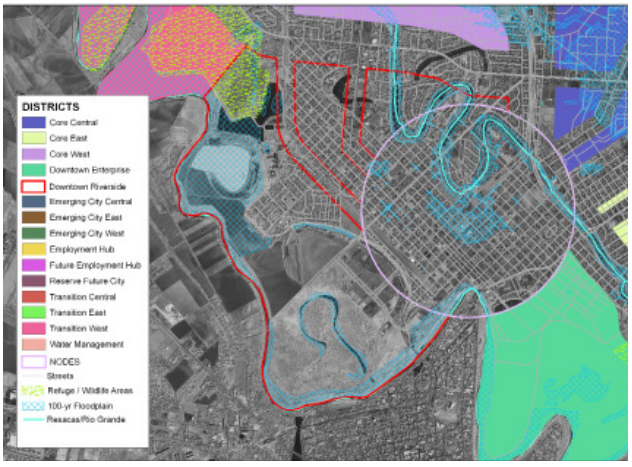

Figure 14. Downtown Riverside Floodplain and Wildlife

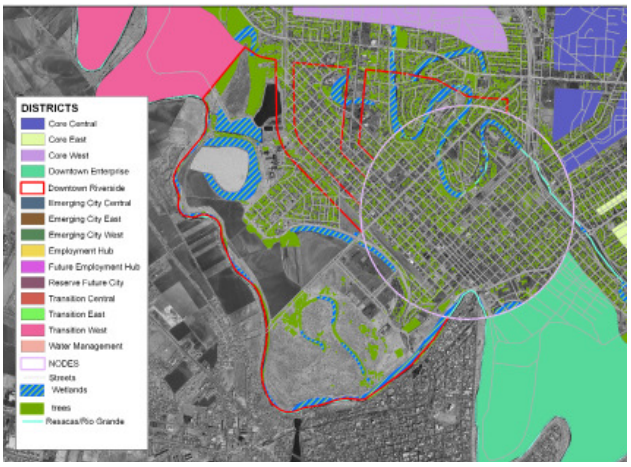

Figure 15. Downtown Riverside District Vegetation and Wetlands

The Downtown Riverside district, south of Boca Chica and North of the Rio Grande on the Western side of the Downtown Node, contains a number of Bancos in addition to portions of the Town Resaca system. The Resaca in this region is largely developed with single family residential homes. Resaca management efforts should focus on bank stabilization to preserve these features as an amenity and prevent further sedimentation and its effects on water quality. While retaining walls are already common in the residential areas bordering this Resaca system to maintain the integrity of the banks, residents should be encouraged to incorporate native landscaping techniques throughout this region enhancing the visual appeal, property values, and the viability of the area to support the wide range of birds and other fauna that lives or visits the region throughout the year. Education and Outreach programs targeting homes along the Resaca should focus on the minimization of pesticide/fertilizer use and responsible water use from irrigation pumps used for lawn watering. Dense regions of tree coverage should be preserved and perpetuated throughout the District to provide habitat for birds and other wildlife, provide shade, temperature moderation and reduced energy consumption, and provide a visual amenity for the community.

Throughout this district and the adjacent downtown node, the Town Resaca system has been subject to significant accumulation of sediment over the past several decades and as such is a key location that should be investigated for dredging

possibilities. Upon dredging, the downstream weir heights controlling the normal water surface elevation in the Resacas should be re-evaluated to determine if the levels can be lowered to provide additional stormwater storage while still preserving water quality and a desirable visual appeal. An alternative to permanently lowering the normal water surface elevation would be to install a remotely operated control structure that could be quickly adjusted to maintain current levels during dry conditions or be rapidly lowered prior to rainfall events. These water level control devices must be maintained at regular intervals in order to ensure proper operation when needed on short notice.

To illustrate and promote the potential function and aesthetics of the Resaca systems an example, "showcase" project could be developed that provides a public amenity in the form of an educational park. A potential site to investigate within the Downtown Riverside District would be at the Cemetery Resaca site just south of the intersection of Palm Blvd. and Harrison. The location of this site relative to Downtown Brownsville, Dean Porter Park, and the Gladys Porter Zoo makes it ideal to maximize the number of potential visitors and residents likely to visit the site. Other potential sites that might serve as "showcases" as well as public/private cooperation are the resacas around St. Joseph's Academy and UTB/TSC. These examples would promote education and outreach, stimulate public involvement, and encourage collaboration between these educational institutions and local government. This strategy is presented in further detail including an approximate budget under Strategy _____.

The southern portion of this district that borders the Rio Grande, south of UTB/ITECC is still largely undeveloped and characterized by low elevations, Bancos, and is partially within the 100-yr floodplain especially in the northwest quadrant of the district. This area is also host to a U.S. Fish and Wildlife Service (USFWS) refuge. The areas bordering the Rio Grande and that are within the floodplain provide an opportunity for a nature/ wildlife corridor and hike/bike trail that leads into the center of downtown (described in further detail under Strategy 4) and borders ITECC (and could potentially be linked to an additional N/S route on the existing railroad ROW that will soon be relocated). Undeveloped areas surrounding these environmentally sensitive areas should be developed in a manner that considers the impact on the surrounding area and provides a transition zone from any potential or existing commercial development. This is particularly important because of the essential role that riparian (or waterside) forest plays as a wildlife corridor for endangered species and other flora/fauna near the Rio Grande River.

Downtown Enterprise District

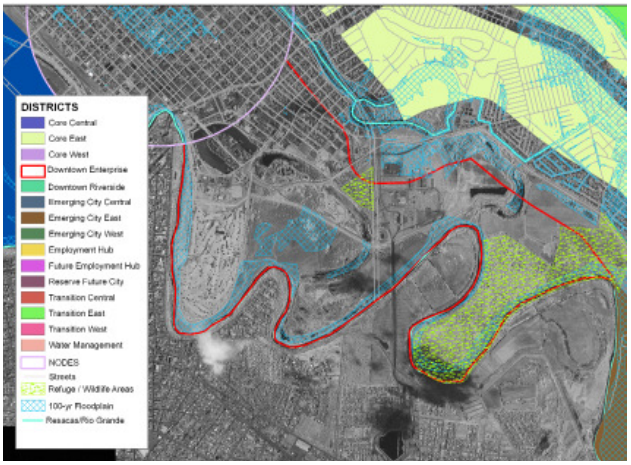

Figure 16. Downtown Enterprise Floodplain and Wildlife

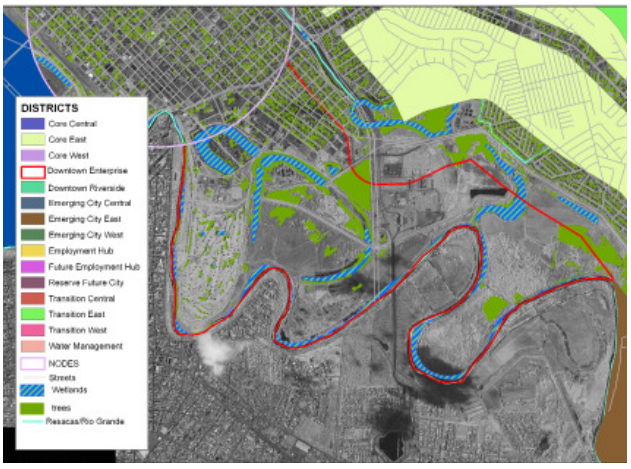

Figure 17. Downtown Enterprise Vegetation and Wetlands

This district is dominated by the presence of the University of Texas at Brownsville including the Fort Brown Municipal Golf Course. The eastern boundary of the district contains additional USFWS property and the entire southern border is adjacent to the Rio Grande River. Within the UTB campus there are two Banco areas that have been incorporated into the landscape of the campus. The first Banco is known as the "Fort Brown Resaca" and is surrounded by educational facilities on the Northeastern portion of the Resaca and faculty/staff and student housing on the Southwestern segment.

The second Banco is adjacent to the new Education and Business Complex that was constructed in 2005.

The construction of this complex was done to incorporate the beauty of the surrounding natural landscape and minimize the impact that the development had on this natural wetland area. The Banco has a wooden, foot bridge over the Resaca that allows students access to this building from the rest of the campus and provides a great location for bird watching and appreciation of these features. This serves as an excellent example of how these unique features can be preserved while still allowing for needed development and expansion. The southern portion of this Banco that is not developed could serve as a nature park area (adjacent to Lincoln Park) that features walking and biking trails, restoration of native flora and fauna and an educational facility (in cooperation with the University and BISD) that would serve to increase appreciation and knowledge of Brownsville's unique natural resources.

This region, contingent on the final construction of the Border Wall could provide an additional corridor along the Rio Grande for a nature corridor/hike and bike trail. This would be viable along the entire length of the district and could be connected to the Downtown Riverside corridor through an Urban Riverwalk development in the developed "Downtown Node". This continuous stretch of trail leading to the Downtown Node from both the east and west portions of Brownsville could be tied into additional N/S hike and bike routes that would provide access to these regions to surrounding residential neighborhoods and provide a substantial amenity to the community.

West Core and West Transition Districts

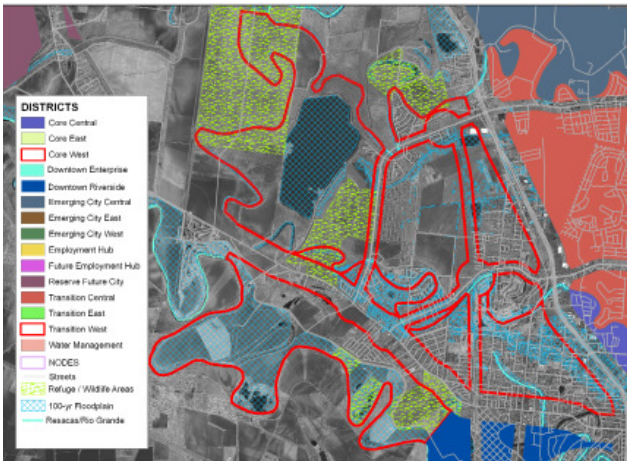

Figure 18. West Core - Transition Floodplain and Wildlife

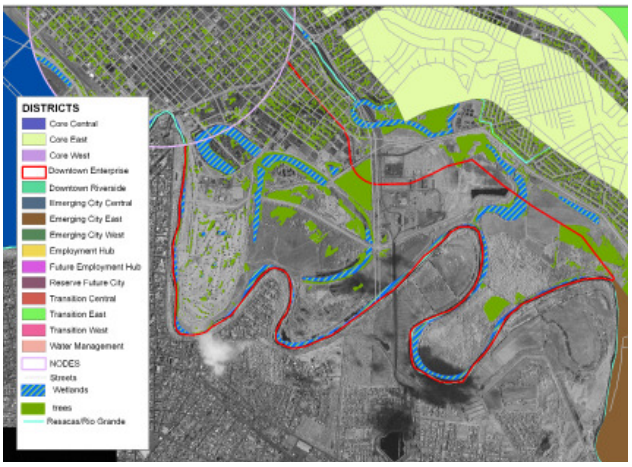

Figure 19. West Core - Transition and Vegetation Wetlands

While these two districts have slightly different allowable landuse type allocations in the landuse plan, in terms of environmental and Resaca management, these two districts will be treated similarly. The two districts contain the upstream end of Resaca de la Guerra (RDLG) that is heavily residential (Villa Nueva, Costa del Sol, Quail Hollow, VICC, etc.) and the area adjacent to the Southern edge of Resaca del Rancho Viejo (RRV) near Lakeway Subdivision and the undeveloped area surrounding the reservoir south of Resaca de la Palma.

The upstream portion of RDLG which is normally dry, is City owned property that functions as a bicycle trail park. The area North/Northwest of this region is largely undeveloped and occupied by the Irrigation District No. 5 and 6 water reservoir. This presents an opportunity for an expanded multi-use regional park that could serve as a detention reservoir during periods of heavy rainfall. The potential to expand the hike/bike trails with a loop around the reservoir could also be explored in this region and connected to the existing trail system and eventually connect to a trail corridor within the Cameron County Drainage District No.1 Ditch No. 1 (CCDD1) right of way. This ditch flows southeast and intersects the existing N/S Linear Park Hike and Bike Trail. The Resaca bed and the rest of the surrounding region should remain vegetated to minimize maintenance costs and provide habitat for birds, butterflies, native plants and other important flora and fauna.

Further downstream in the vicinity of Quail Hollow, the Resaca has been subject to extensive sedimentation, greatly diminishing water depth and water quality. This region, due to the extensive sediment accumulation and its geographic location being in the upstream portion of the Resaca, makes it a priority for any future dredging plans. Upon dredging, controlling downstream weir structures should be re-analyzed to ensure adequate water depths in the Resaca to maintain water quality while maximizing the amount of stormwater detention in the Resaca bed to minimize the flow rate draining into VICC which has been historically prone to flooding.

Like the residential areas in the Downtown Districts, bank stabilization should be encouraged along with the incorporation of native flora in the residential areas around the Resacas. The commercial areas on the Eastern side of the two districts, along the West side of US 77/83, should incorporate vegetated buffers of at least 30-ft between roadways and parking lots and Resacas. The buffers would serve to filter roadway pollution before draining into the Resaca. Native trees should also be encouraged along commercial Resaca boundaries to maintain a level of continuity between open space, residential, and commercial land uses.

Core Central and Core Transition Districts

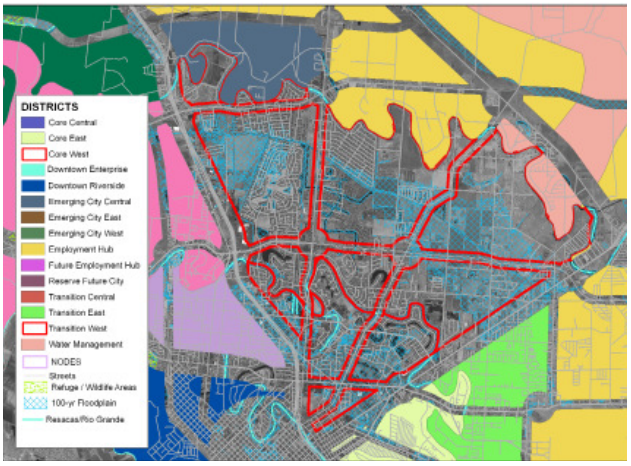

Figure 20. Central Core - Transition Floodplain and

Wildlife

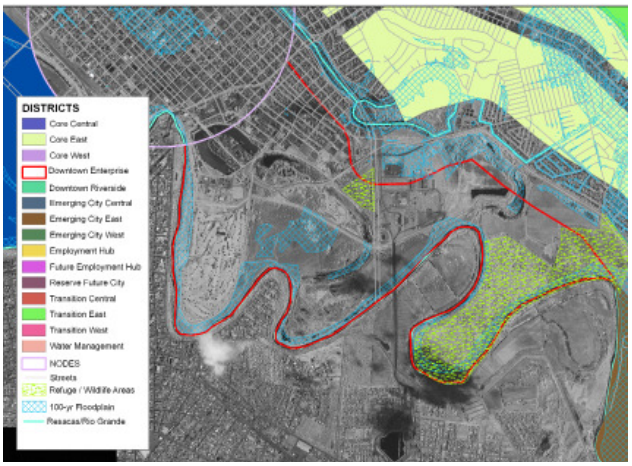

Figure 21. Downtown Enterprise Vegetaion and Wetlands

These two districts cover the area between US 77/83 and Highway 48 South of Resaca del Rancho Viejo. While a majority of the landuse in these districts is a mix of residential and commercial, the use along RDLG and the Southern side of RRV is predominantly residential and warrants similar recommendations regarding bank stabilization, education and outreach and the incorporation of native trees and plants.

One of the key issues that affects these two districts are the large floodplain areas that exist in each one. These large areas indicate insufficient capacity in the drainage system and the need for ditch expansions and off-site detention. Specific drainage strategies are addressed in the drainage section of the Utilities Section of the report but include acquiring right of way for future ditch expansions, and purchasing land and developing multi-use detention facilities that function as parks and open space during dry weather conditions. In addition to these remediation strategies, drainage policies regarding future developments should be reinforced and made consistent across the entire City planning area to ensure that flood conditions are not exacerbated as the region continues to grow. Furthermore, while most residential and commercial development should be restricted in the floodplain whenever possible, in situations where it is not possible, strategies for removing the areas from the floodplain should be developed and property owners should be required to purchase flood insurance from FEMA. At a minimum, appropriate floodproofing technology should be implemented by these extremely floodprone developments.

These two districts also contain the majority of existing hike and bike trails within the City including the linear park hike and bike trail along the abandoned rail line that parallels Paredes Line Road and the Paseo de la Resasa trail system southeast of Paredes Line Road and CCDD1. This system informally connects to the Linear Park, creating over 15 miles of trail for public use. This trail system also directly connects to CCDD1 providing the opportunity for the expansion of this system by providing a trail in the ditch ROW that runs east-west across the City and would provide accessibility to other parts of the community. Construction of the trail should incorporate native trees along the corridor to add visual appeal, provide shade in addition to bird/butterfly habitat. In addition to providing a valuable amenity to local residents and winter Texans, the expansion of a trail/nature corridor throughout Brownsville to attract various birds and butterfly species promotes ecotourism in the region by appealing to visiting birders. Additionally, supporting hike and bike trails encourages increased activity providing health benefits to residents and potentially working to lower preventable disease rates in addition to healthcare costs.

Core East and East Transition Districts

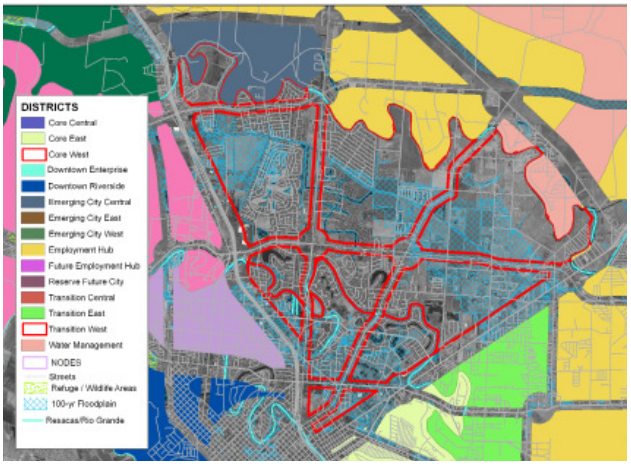

Figure 22. East Core - Transition Floodplain and

Wildlife

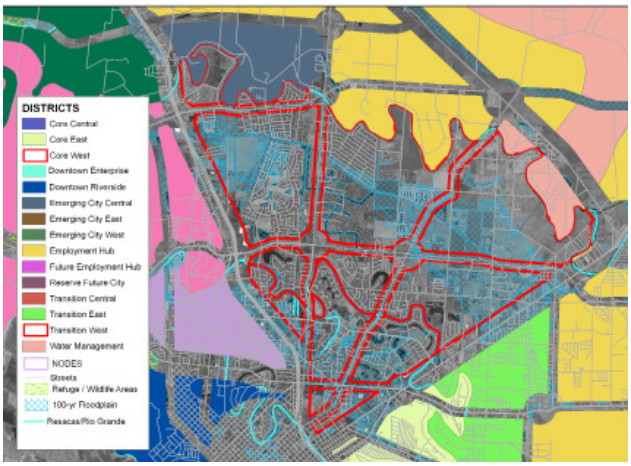

Figure 23. East Core - Transition Vegetation and Wetlands

These two Districts are located East-Southeast of the Four Corners area at the intersection of Highway 48 and Boca Chica. The two districts envelope the downstream portion of RDLG and are a mix of residential and commercial development. Resacas here should be treated similarly to other areas with residential and commercial development. The presence of a significant floodplain area in the northern portion of the Core East District necessitates flood mitigation in that area. A possible project, as highlighted in the drainage section, would be to construct a multi-use detention pond adjacent to the new Botanical Gardens near Owen's Road. In addition, to off-site detention, improving flow efficiency and capacity in this downstream portion of North Main Drain (NMD) is also of importance and measure should be taken now to reclaim and acquire right of way (ROW) along the ditch and procure funding to expand the ditch. Hike and Bike trails could also be constructed within the ROW.

The increased industrial and commercial development that is emphasized in the landuse plan in this district necessitates special consideration of the impact on drainage and water quality in the RLDG. In addition to vegetated swales, additional strategies may need to be developed at stormwater inlets to minimize the influx of undesirable contaminants via stormwater entering the resacas and drainage ditches (that eventually drain to San Martin Lake. Examples of such strategies include oil and grit separators, infiltration ponds at potential runoff pollution sources and education/outreach activities.

Emerging City East District

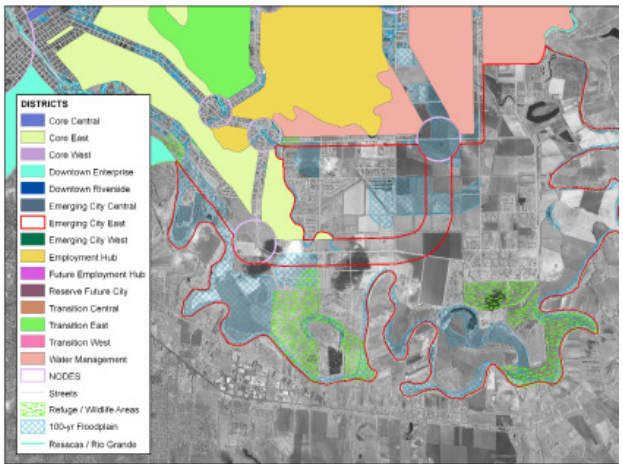

Figure 24. Emerging Future City East District Floodplain and Wildlife

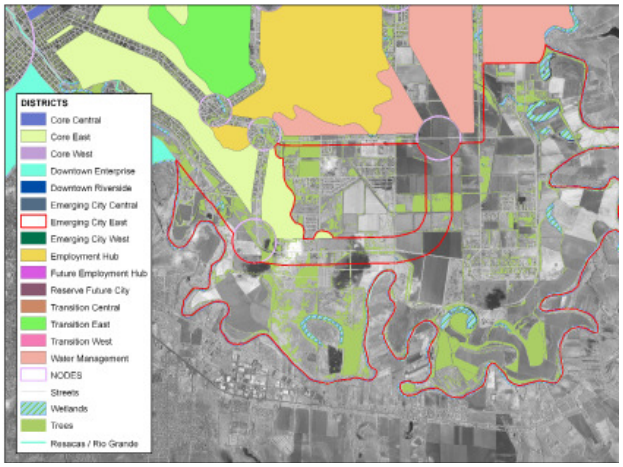

Figure 25. Emerging Fuure City East District Vegetation and Wetlands

This District is located in the southernmost portion of the City and as of current is largely undeveloped with significant agricultural lands and Rio Grande River riparian woodland / thorn scrub. A small section of this district is residential. The proposed East Loop corridor will bisect the District as it runs towards the Port and as such will accommodate some degree of industrial and commercial usage in the future but mostly single family residential as agricultural lands are converted.

The District borders the Rio Grande and contains several key tracts of environmentally sensitive habitat including the Sabal Palm Sanctuary which is the largest remaining tract of Sabal Palm trees in the U.S. Surrounding this site is additional USFWS refuge area to both the east and west which could be connected with hike and bike trails along the Rio Grande or surrounding area. This system could run all the way along the Rio Grande west and connect with the trail proposed in the Downtown Districts and provide access to existing and future residential developments to the Downtown area. Any future commercial and/or industrial development should be conscious of the environmental sensitivity of this region and take necessary precaution to minimize impacts and provide vegetated buffer zones between these areas and Park/Rio Grande Corridor regions.

It is important to point out that the proposed Border Fence will likely have a significant impact on the riparian woodlands/thorn scrub as well as other essential wildlife habitat in this area. Future hike and bike trails may also be negatively impacted by this proposed action.

Emerging City Central and Emerging City West Districts

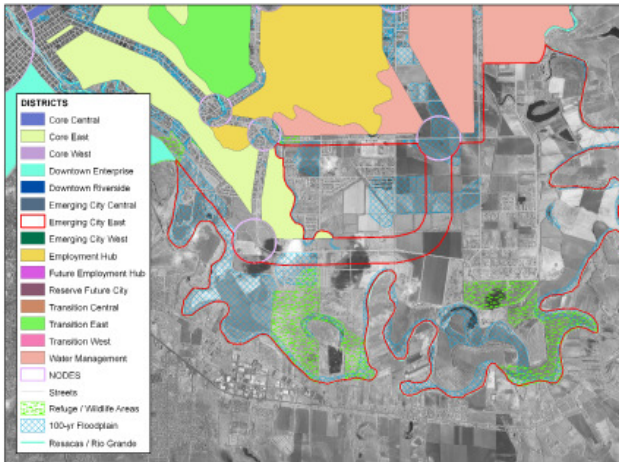

Figure 26. Emerging Fuure City Central - West Districts Floodplain and Wildlife

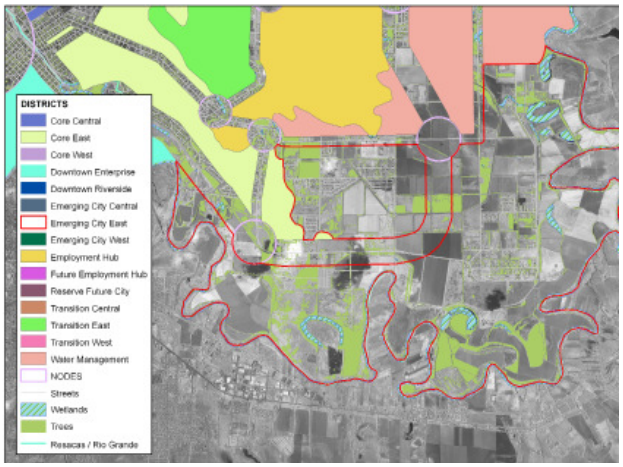

Figure 27. Emerging Fuure City Central - West Districts Vegetation and Wetlands

These Districts contain a portion of the Resaca del Rancho Viejo System and the Resaca de la Palma State Park and Birding Center in addition to a U.S. Fish and Wildlife area directly north/northeast of the Lakeway Subdivision. Future development occurring in these districts should be sensitive to these features and maintenance of the natural riparian corridor along the undeveloped portions of Resaca del Rancho Viejo should be preserved. Commercial/Industrial development in this region is limited and residential developments should adhere to the recommendations described earlier in this section. The Resaca extending Northeast of the Resaca de la Palma State Park and Birding Center presents an opportunity for additional public access to the Resaca providing an amenity for residents and additional birding area to

support the eco-tourism industry.

Water Management District

As stated in the Landuse Plan, this large District on the easternmost portion of the City is dominated by large-spread floodplains and designated wetland areas that are not suitable for development. The focus in this region should be on habitat preservation with limited recreational access and educational facilities. It is important to note that this area surrounds the Port of Brownsville and the Employment Hub District where emphasis will be placed on Commercial and Industrial uses. It is therefore important in these surrounding Districts to be conscious of their vicinity to this environmentally sensitive region and all measures possible should be taken to provide a buffer region between industrial/commercial development and Water Management District area and minimize negative environmental impact.

Employment Hub District

The Employment Hub District will host the majority of industrial development in the City allowing for maximum utilization of the transportation infrastructure that exists in the form of the Port, Airport, Rail lines, and FM 511 and Future East Loop Corridor. While the focus of this District is not environmental resources and preservation, as indicated in the Landuse Plan, special effort should be taken to incorporate vegetated landscape buffers to preserve the continuity of viewsheds between this region and other Districts and to shield pedestrian and residential zones from industrial activity. Special consideration should also be made in the portions of the District that border and/or contain the downstream portion of Resaca del Ranco Viejo. These areas within the District are where residential development and park space should be provided that implements the Resaca management strategies discussed in other Districts (i.e. bank stabilization, native flora, etc.).

Future Employment Hub District

The majority of this District is located within both the 100-yr floodplain and a large tract of designated wetland area. As the landuse plan states, this area should remain undeveloped until the area is needed to accommodate industrial growth at the Port of Brownsville. At that time, the suitability of this area for various types of development should be re-evaluated to ensure that it can be done in a manner to minimize negative impact to the surrounding wetland system. For example, industrial development immediately adjacent to the Ship Channel may be possible if sufficient buffer area is provided between developed areas and designated wetland tracts. Future development in these areas should also include sufficient study of environmental impact and a plan to contain activities within designated areas to prevent pollution of surrounding tracts of important environmental resources including the Bahia Grande Complex of the Laguna Atascos National Wildlife Refuge to the Northeast and the Lower Rio Grande National Wildlife Refuge to the South and Southeast.

Reserve Future City

This District remains largely undeveloped with areas of agricultural use and some large lot, single family homes. Resaca de Los Cuates traverses from West to East across the District and exhibits a more natural, riparian corridor than the other more developed Resacas of RDLG and TR (and RRV to some extent). The District also contains large areas of wildlife parks and reserves including the southern portion of Laguna Atascosa where several sightings of rare Ocelots have been recorded over the last several years. As suggested in the Landuse Plan, development in this area should be restricted to promote higher density and infill growth in the core of the City allowing this area to serve as a key area for expansive habitat corridors and open space. Resaca de Los Cuates provides a potential corridor for connecting refuge areas west of US 77/83 to Laguna Atascosa on the east side of the City's ETJ and could incorporate hiking trails along the northern bank of the Resaca.

12. Develop a long-term Resaca management plan that tracks the physical, chemical, biological, and hydrological conditions of individual Resaca pools in order to maximize their environmental, flood protection,

aesthetic, and recreational benefits.

There is notable lack of physical, chemical, biological, and hydrological data on Brownsville area Resacas. As such, it is virtually impossible to formulate sound policy with respect to their utilization and/or preservation. It is recommended that one over-arching governing body be tasked with the responsibility to develop a long-term resource management system to not only safeguard this precious resource, but to maximize their utility from a sustainable and equitable viewpoint.

A general outline of the steps required to develop this management system is presented below in four phases. The phases progress from the preliminary collection of essential, but basic baseline data toward the development of more advanced analyses that can be done in the future as time and budgets permit.

All collected data should be formatted and analyzed in a GIS system such as the one described in Strategy 8.

Phase I

1. Develop and disseminate a standardized naming system that will provide each Resaca, and their constituent lakes, with a unique name and/or identifier. This naming system should be simple and straightforward and should lend itself to the fact that the Resacas currently consist of a highly fragmented series of individual pools or lakes divided by roads, culverts, railway crossings, and other hydraulic control mechanisms. The system should also be disseminated to all relevant stakeholder agencies including city, county, and state agencies so that a single system can be utilized for future study and planning.

One naming system that has been used in previous hydrologic analyses involves the assignment of a two letter code identifying the Resaca, followed by a dash and number, with the number representing a link, lake, or separate pool of that particular Resaca. The numbering system should begin with the lowest number being assigned to the upstream pool. For example, the northwestern most pool of the Town Resaca is often labeled TR-1. This pool or link begins at the "headwaters" of the Town Resaca and extends downstream until the first road crossing or other major hydraulic mechanism is encountered. At that point, TR-2 begins. The numbering system continues until the Resaca reaches its terminus or drains into another named system or drainage ditch.

This example utilizes a structure, formal naming system for analysis, ready reference and future study. A more informal naming system can and should be developed utilizing many of the already existing names given to these individual pools by the public. For example, the Fort Brown Resaca near UTB/TSC, the Media Luna Resaca near FM 802 and Old Alice Rd, etc.

2. The development of a standardized, professionally designed, and agreed upon map in a GIS system that utilizes the naming system of step one above. A map like this could be used for a variety of purposes including: education and outreach, ecotourism, use in walking/nature trail kiosks, etc.

3. Collection and recording in a GIS system of a variety of essential water resource characteristics and physiochemical parameters for each pool, such as:

- Water depth and variability over time
- Sediment thickness
- Volume to surface area ratio
- Calculation of flood storage capacity
- Upstream / Downstream hydraulic structure identification / confirmation / and maintenance condition (such as the existence and condition of reinforced concrete pipes and / or box culverts, etc.)
- Bank characterization to include percentage of shoreline that is either natural banks or lined with bulkheads / retaining walls
- Identification of type and number of invasive species in native area riparian forests
- Watershed to surface area ratio
- Watershed delineation to include secondary stormwater drainage area
- Existing water level management practices to

include identification of level control structures and rules of operation for these structures, number and type of pumps for water transfer, etc.

- Flow analysis throughout the entire Resaca system to include natural runoff, watershed estimations, flow control structures, pumping mechanisms, and identification of isolated ox-bows that have no water level controls.
  - Basic water quality parameters to include:
  - Dissolved oxygen
  - Biochemical oxygen demand
  - Temperature at various depths
  - Salinity at various depths
  - Turbidity
  - Phosphates
  - Nitrates
  - Algae concentration estimates (using chlorophyll-a and secchi disk)
- Identification of existing water quality improvement mechanisms such as aerators, swales, separators, storm drainage labeling, etc.

Phase II:

1. Plant and animal species diversity, abundance and richness estimates

2. Sediment loading study

3. Sediment characterization study

4. Nutrient loading and characterization of primary contaminants of concern including fertilizers, pesticides/herbicides, BOD, etc.

5. Debris and refuse hotspot identification

6. Water withdrawal and loss estimations
- Including rainfall studies, evaporation and seepage estimates
- Water withdrawal study to include identification of irrigation usage sites and possible regulation / permitting

7. Identification of areas in need of dredging for water quality improvement and/or flood storage capacity augmentation.

Phase III:

1. Calculation of appropriate depth and water level maintenance
2. Investigation and feasibility analysis of strategies to augment existing water allotment for water level maintenance and flow augmentation
- Acquiring additional water withdrawal rights from the Rio Grande River with a percentage of these rights being listed an non-consumptive use.
- Water reuse of wastewater treatment plant discharges
- Reduction of evaporation through:
  - Proper placement of tall native trees on the windward side of resacas to act as windbreakers
  - Removal of invasive, high water usage plants such as Salt Cedar, Brazilian Pepper Tree, etc.
  - Increase depth by dredging
  - Increase watershed area through increased secondary stormwater drainage systems
  - Divert floodwater from drainage canals to Resaca systems
  - Flow augmentation

- Designing outlet works so that warmer surface water is released first

3. Investigation of methods for water quality improvement including but not limited to:

- Additional aerators (perhaps solar powered)
- Flow augmentation through river water diversion strategy
- Shoreline stabilization utilizing native plant species
- Swales and buffer zones
- Development of a debris removal plan
- Sediment catchments

4. Algal bloom study and identification of off-the-shelf emergency treatment options to combat algal blooms at first sign of occurrence.

5. Development of integrated management plan that combines the above data and studies with the long-term land use plans identified in sections 6 & 7 to maximize the utility of the Resaca systems.

6. Develop a utility ranking system rating the utility of each Resaca pool or lake in each of the following categories:

- Visual amenity
- Wildlife habitat
- Stormwater drainage and storage
- Emergency raw water supply
- Irrigation water transfer, storage, and supply
- Ecotourism – birding, nature trails, native flora and fauna, wildlife observation blind potential, etc.
- Enhancement of park space
- Visual enhancement of public/private lands
- Temperature moderation
- Water supply for native, riparian forest strands
- Recreation – kayaking, fitness and nature trails, fishing, etc.

Implementation: Environmental technical group in partnership with UTB/TSC, BISD, community groups and federal and state agencies.

13. Expand and connect existing trail system

This strategy involves actively investing in and developing a trail network throughout the City. The benefits of such a strategy include: increased appreciation of Brownsville's abundant natural resources, increased activity leading to decreased instances of preventable diseases, decreased vehicular traffic and resulting CO2 emissions, decreased wear and tear on roadways resulting in lower road maintenance costs and increased property values along trail corridors.

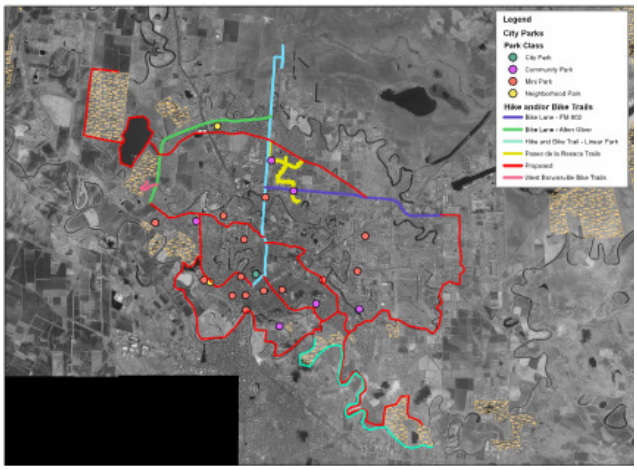

Figure 28. Overall Trail System

The expanded system Figure 28 can be developed over the course of several years but initial projects should aim at constructing segments that directly link to existing corridors throughout the City. The proposed segments presented focus on utilizing available right of ways and attempting to link residential areas to schools and parks/ refuges/open space. Specific segments and approximate costs are highlighted below. While some degree of flexibility exists in the order that segments can be developed, some consideration needs to be as to which segments provide direct connections to existing systems (now and in the future) to maximize the overall benefit provided and overall mobility.

Segment 1:

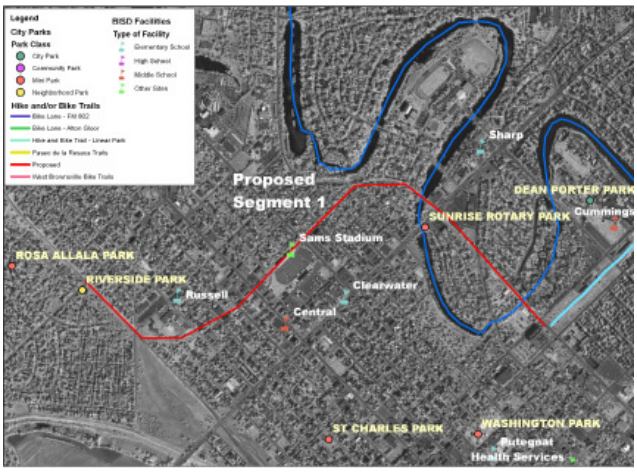

Figure 29. Segment 1

This first segment Figure 29 of the proposed trail system would connect Downtown Brownsville to the existing N/S Hike and Bike trail from Riverside Park along the abandoned rail line. The entire length of the proposed trail is approximately 1.6 miles in length. This segment is given priority due to its proximity to large residential areas, parks, the zoo, and school facilities.

Approximate Cost of 6-ft wide asphalt surface: $135,000
Approximate Cost of Landscaping and irrigation: $85,000 - $125,000
Approximate Cost of Signage and Trash Receptacles: $2000
Total Approximate Cost of Segment 1: $222,000 - $262,000

Segment 2:

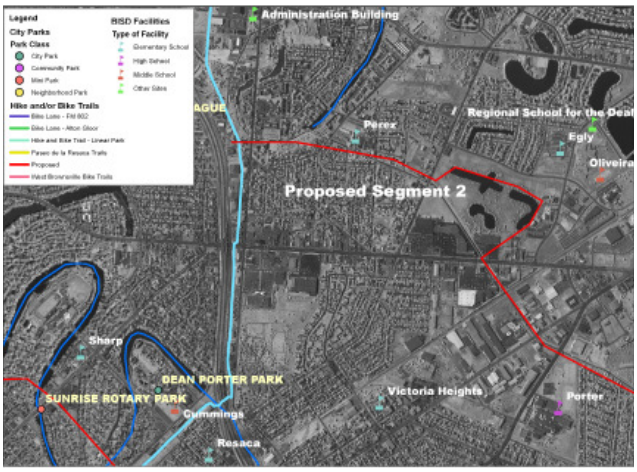

Figure 30. Segment 2

This second segment Figure 30 of the proposed trail system would connect the existing N/S Hike and Bike trail from the crossing of North Main Drain and follow the drainage ditch down to Ruiz Park and the new Botanical Gardens near Owens Rd. Pedestrian bridges should be placed at key locations as funding allows in the future, allowing residential regions to have access to the trail that may be on the far side of the ditch. The entire length of the proposed trail is approximately 2.6 miles in length.

Approximate Cost of 6-ft wide asphalt surface: $220,500
Approximate Cost of Landscaping and Irrigation: $138,000 - $207,000
Approximate Cost of Signage and Trash Receptacles: $4000
Approximate Cost of Pedestrian Bridges (2): Varies
Total Approximate Cost of Segment 2 (without bridges): $362,500 - $431,500

Segment 3:

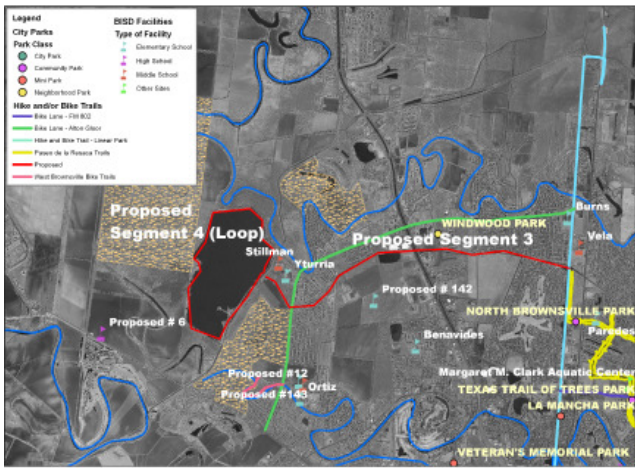

Figure 31. Segment 3

This segment Figure 31 of the proposed trail system would connect west Brownsville near Stillman and Yturria Schools and the West Brownsville Bike Park to the linear park along CCDD1. The entire length of the proposed trail is approximately 3.9 miles in length and would provide a safer alternative to the existing bike lanes on Alton Gloor Blvd. Implementation of this strategy would require coordination with Cameron County Drainage District 1

Approximate Cost of 6-ft wide asphalt surface: $330,000
Approximate Cost of Landscaping and irrigation: $206,000 - $309,000
Approximate Cost of Signage and Trash Receptacles: $6000
Total Approximate Cost of Segment 3: $542,000 - $645,000

Segment 4:

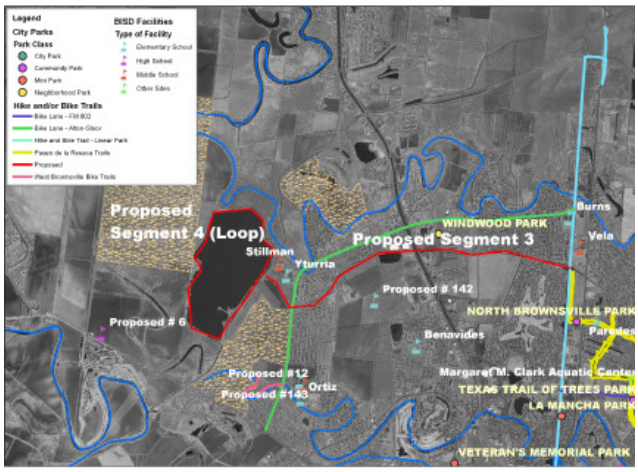

Figure 32. Segment 4

This segment Figure 32 of the proposed trail system would connect proposed Segment 3 to a 4-mile loop around the water reservoir on the west side of the City. This loop would serve as a jogging and mountain biking trail and could be designed as a bare earth trail removing the need for expensive paving. Landscaping and irrigation costs could also be removed due to the existing dense tree coverage that already exists in this region. Implementation of this strategy would require coordination with Cameron County Irrigation District Number 6.

Approximate Cost of 6-ft wide bare earth trail: $169,000
Approximate Cost of Signage and Trash Receptacles: $2000
Total Approximate Cost of Segment 4: $171,000

Segment 5:

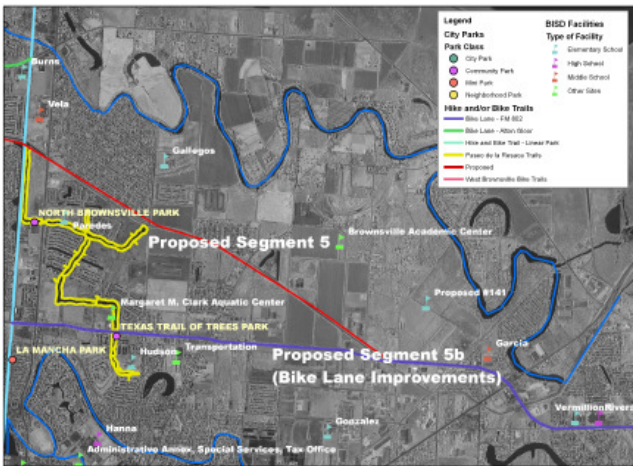

Figure 33. Segment 5

This segment Figure 33 of the proposed trail system is a continuation of proposed Segment 3 and would continue down the CDD1 ROW to FM 802. The entire length of the proposed trail segment is approximately 3.3 miles in length and would connect the existing linear park to the bike lanes on FM 802. Part b of this segment includes providing a physical barrier between the bike lanes on FM 802 and the actual roadway to improve the overall safety of the corridor. An example may be viewed in Figure __. Implementation of this strategy would require coordination with Cameron County Drainage District 1

Approximate Cost of 6-ft wide asphalt surface: $280,500
Approximate Cost of Landscaping and irrigation: $175,000 - $263,000
Approximate Cost of Signage and Trash Receptacles: $5000
Total Approximate Cost of Segment 5: $723,500

Segment 6:

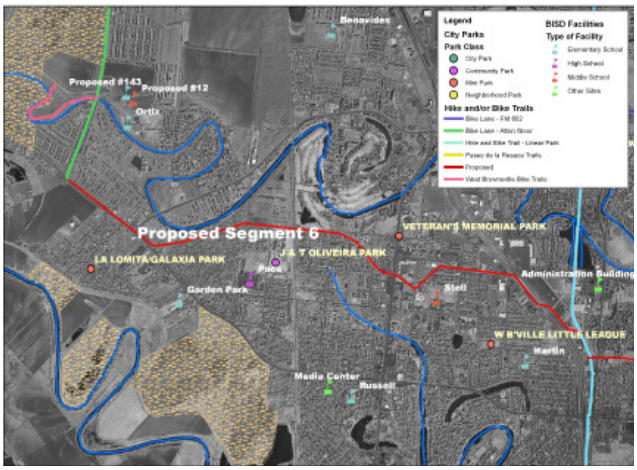

Figure 34. Segment 6

This segment Figure 34 of the proposed trail system runs along the NMD on the west side of the freeway and connects to the Alton Gloor bike lanes. The entire length of the proposed trail segment is approximately 3.9 miles

Approximate Cost of 6-ft wide asphalt surface: $330,000
Approximate Cost of Landscaping and irrigation: $206,000 - $309,000
Approximate Cost of Signage and Trash Receptacles: $6000
Total Approximate Cost of Segment 6: $542,000 - $645,000

Segment 7:

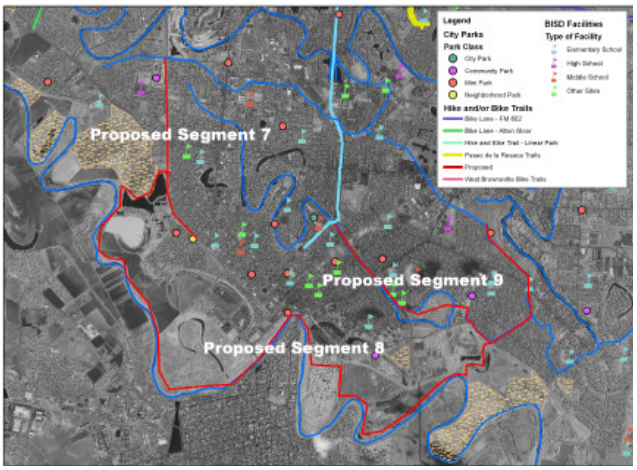

Figure 35. Segment 7

This segment Figure 35 of the proposed trail system is a continuation of Segment 1 at Riverside Park heading north along the soon to be relocated rail line. This segment would provide access to Segment 6 from West Brownsville. The entire length of the proposed trail segment is approximately 2.1 miles.

Approximate Cost of 6-ft wide asphalt surface: $178,000
Approximate Cost of Landscaping and irrigation: $111,000 - $166,000
Approximate Cost of Signage and Trash Receptacles: $3000
Total Approximate Cost of Segment 7: $292,000 - $347,000

Segment 8:

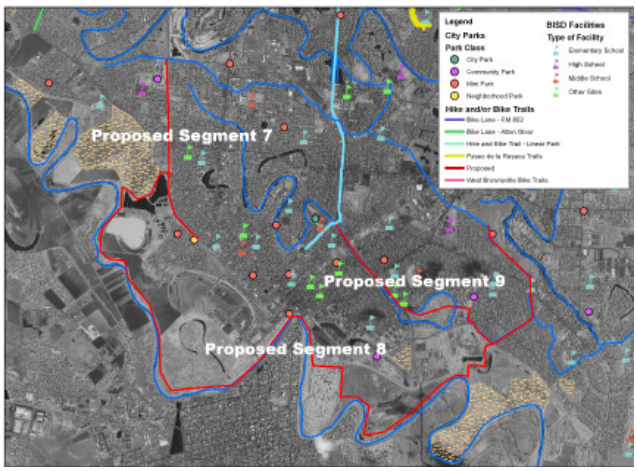

Figure 36. Segment 8

This segment Figure 36 of the proposed trail system extends along the Rio Grande River from the BPUB north water treatment plant to the intersection of Segment 8 at Town Resaca. The entire length of the proposed trail segment is approximately 9.1 miles and would require coordination with the Department of Homeland Security, IBWC, and local landowners.

Approximate Cost of 6-ft wide asphalt surface: $769,000
Approximate Cost of Landscaping and irrigation: $480,500 - $720,750
Approximate Cost of Signage and Trash Receptacles: $10,000
Total Approximate Cost of Segment 8: $1,259,500 - $1,499,750

Segment 9:

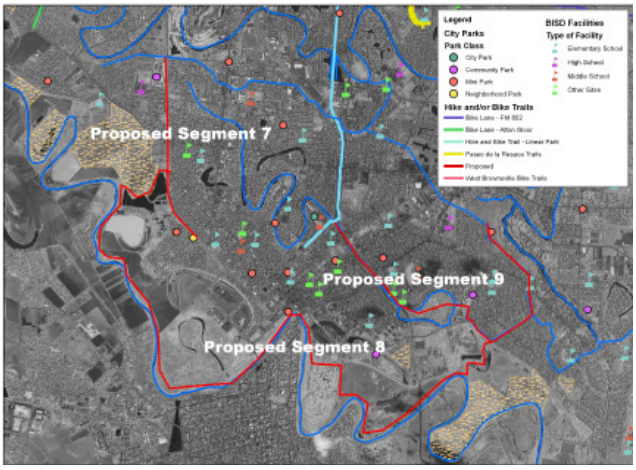

Figure 31. Segment 9

This segment (Figure _) of the proposed trail system would extend from the existing Linear Park trail near Dean Porter Park and follow the Town Resaca system to NMD. The entire length of the proposed trail segment is approximately 4.2 miles

Approximate Cost of 6-ft wide asphalt surface: $355,000
Approximate Cost of Landscaping and irrigation: $221,750 - $332,650
Approximate Cost of Signage and Trash Receptacles: $6000
Total Approximate Cost of Segment 9: $582,750 - $693,650

Segment 10:

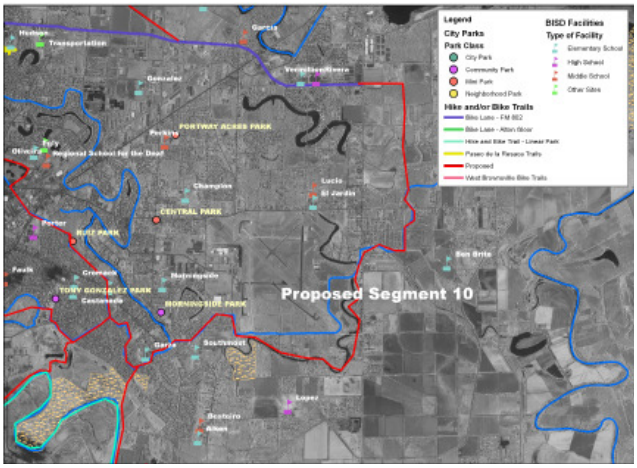

Figure 32. Segment 10

This segment Figure 32 of the proposed trail system continues along NMD past Segment 9 and heads north to connect back to the bike lanes on FM 802 completing the loop. The segment between the NMD and FM 802 would require coordination and establishment of ROW with local landowners. The entire length of the proposed trail segment is approximately 8.7 miles

Approximate Cost of 6-ft wide asphalt surface: $735,000
Approximate Cost of Landscaping and irrigation: $460,000 - $689,000
Approximate Cost of Signage and Trash Receptacles: $8000
Total Approximate Cost of Segment 10: $1,203,000 - $1,432,000
I

Segment 11:

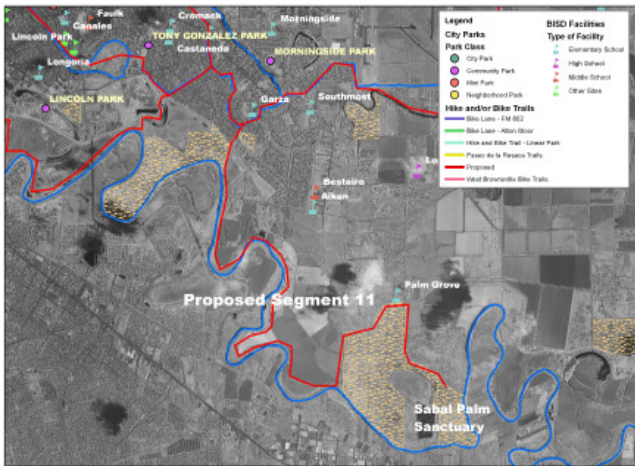

Figure 33. Segment 11

This segment Figure 33 of the proposed trail system extends from the proposed segment along NMD and terminates at the Sabal Palm Sanctuary in South Brownsville. The entire length of the proposed trail segment is approximately 7.7miles and would require coordination with the Department of Homeland Security, IBWC, and local landowners.

Approximate Cost of 6-ft wide asphalt surface: $647,000
Approximate Cost of Landscaping and irrigation: $404,000 - $606,500
Approximate Cost of Signage and Trash Receptacles: $7000
Total Approximate Cost of Segment 11: $1,058,000 - $1,260,500

Segment 12:

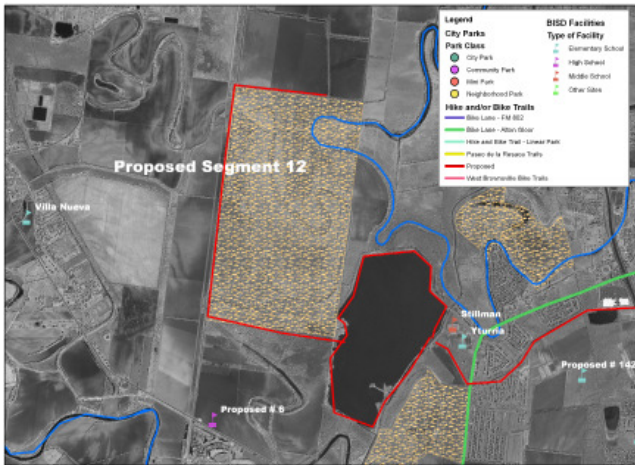

Figure 34. Segment 11

This segment Figure 34 of the proposed trail system connects the mountain biking/jogging loop in Segment 4 to the Resaca de la Palma State Park and Birding Center with additional bare earth trail. Implementation of this strategy would require coordination with Texas Parks and Wildlife as well as Cameron County Irrigation District Number 6. The entire length of the trail is 3.9 miles.

Approximate Cost of 6-ft wide bare earth trail: $165,400
Approximate Cost of Signage and Trash Receptacles: $2000
Total Approximate Cost of Segment 4: $ 167,400

Canoe Trail:

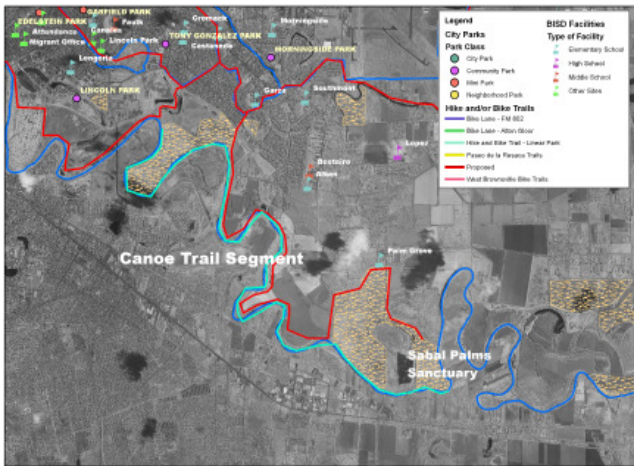

Figure 35. Canoe Trail

This segment Figure 35 of the proposed trail system is a "canoe trail" from a site east of Lincoln Park to the Sabal Palm Sanctuary. The entire length of the proposed trail segment is approximately 9.4 miles and construction of the necessary access ramps would require coordination with local landowners, U.S. Army Corps of Engineers, Department of Homeland Security, IBWC, and the Sabal Palm Sanctuary.

Approximate Cost of two (2) access ramps and Bank Stablization: Varies depending on specific site characteristics
Approximate Cost of Signage and Trash Receptacles: $2000
Total Approximate Cost of Canoe Trail: Varies

14. Cemetery Resaca Restoration Project

In the heart of the Downtown Node is the historic Cemetery Resaca, part of the Town Resaca system upstream of the Gladys Porter Zoo on the corner of E. Madison and E. 5th Street (Figure xx6a). This segment of the Resaca is bordered to the South by the historic Brownsville City Cemetery seeping with history and a popular site to view Brownsville's red-crowned parrots.

On the north side of the Cemetery there is an approximately 30-ft caliche road that runs 10-20-ft from the edge of the Resaca (Figure xx6b).

The Resaca at this location has experienced high levels of sedimentation (between 2.5 – 4 ft) impacting both water quality and aesthetics. Restoration of this site involves dredging the excess sediment from the Resaca, installation of a flow control structure and restoration of the wetland bank lined (Figure xx6c) with pathways and viewing docks to provide access and a unique learning and wildlife viewing area for residents and visitors (Figure xx6d). Resaca aerators should be installed to maintain appropriate oxygen levels in the Resaca, as well as to provide a visual amenity.

Overall, implementation of this project could provide the City with a valuable aesthetic amenity providing opportunities for residents and visitors and serve as an example of proper Resaca management that preserves natural features and important riparian habitat, while still providing people access to enjoy these resources. The site could also be a valuable education tool for BISD and UTB/TSC to learn about water management, drainage, ecosystems, etc. and provide another destination for tourists to view birds and other wildlife.

Figure 36. Historic Cemetary Resaca.

The estimated cost of this project including all dredging, hauling, wetland restoration, flow structures, landscaping, observation decks and walkways is approximately $4 million. The second phase of this project could include an educational facility through a partnership between UTB/TSC, BISD, and the City. The facility could provide a venue for educational seminars, classroom facilities, and to provide information to residents and visitors on Resacas, wetlands, native flora and fauna and drainage.

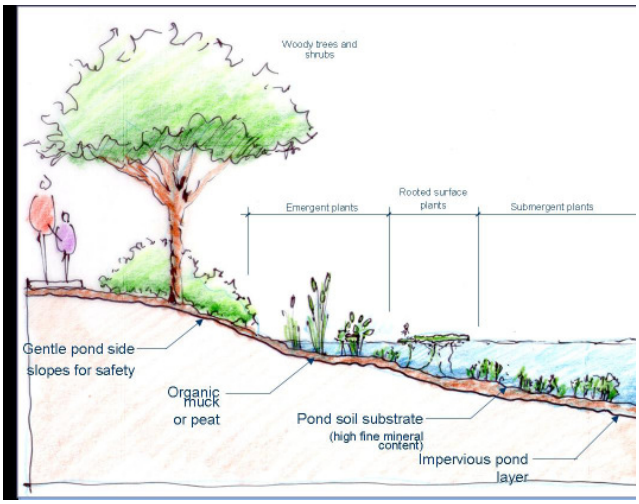

Figure 37. Restoration of the Wetland Bank.


Figure 39. The Restored Cemetary Resaca Bank.


Figure 38. Road Adjacent to Cemetary Resaca.

15. Expand the street sweeping program

Street sweeping activities clean up litter, debris and other materials that collect along the side of a street and properly dispose of the material. Increasing the frequency and distribution of these services throughout the community would improve the aesthetic quality of the City, improve water quality in local surface water bodies, protect aquatic habitat, and improve local, secondary drainage issues caused from clogged storm sewers. While such activities are important throughout the entire community for aesthetic and drainage purposes, extra attention should be paid near sensitive water bodies like Resacas and the Rio Grande River due to the negative impacts that certain types of litter (plastics, bags, etc.) can have on water quality and native flora and fauna.

Overall Environmental Indicators:

To evaluate Brownsville's current status in meeting the stated objectives and to track future progress as strategies are initiated, the following set of indicators Figure 40 should be monitored and evaluated. The indicator table includes recommended "Target" values 5-yrs after initiation of the plan based on standards of comparison and a rough evaluation of what seems reasonable over the short-run. It should be further noted that due to the issues discussed earlier in this section with regards to data availability and tracking, many baseline conditions are not currently monitored. One of the main priorities of this plan is to begin collecting, monitoring, and reporting key environmental datasets to more effectively manage environmental resources throughout the community.

Implementation:

Implementation of this plan requires a coordinated effort between many groups and entities. The environmental technical group will have the initial responsibility of gathering the relevant parties as indicated within each strategy and should be involved throughout the implementation process. The most critical first step is to create a designated task force to explore alternative funding sources for the projects recommended in this plan. The community has voiced a strong desire for expanded recycling services and capacity and this should be given top priority. Additionally, better overall management, mapping and monitoring of environmental resources is critical for their preservation, especially, in relation to Brownsville's unique Resaca systems. Through improved and integrated planning of environmental resources in conjunction with landuse and economic development, these features will be preserved for future generations of residents, flora and fauna and once again become a strong defining feature of the City.

Indicator	Current	Standard of Comparison	5-yr Target
Grant / External Funding $ brought to City by Task Force for Environmental Projects	N/A	N/A	$70,000
Number of Successfully Funded and Implemented Environmental Projects that Address a Key Issue Identified in the Environmental Plan	N/A	N/A	3
Cost per household per year for providing curbside recycling service	N/A	Varies	$35.40
Benefit received from sale of recycled goods	Track	Varies	$5 / ton
% Community participation in curbside recycling program	Track	29% (San Antonio)	20%
% Residents who report being satisfied or very satisfied with recycling program	12%	N/A	50%
% waste diverted from landfill	< 1%	13% (San Antonio)	15%
Per capita solid waste production and growth rate	5.4 lbs/capita/day	4.4 lbs/capita/day	4.4 lbs/capita/day
% stablized Resaca banks	Track		
Average Water Quality Parameters	Track		
% total Resaca miles with native plant and tree growth	Track		
Air Quality - # of days PM 2.5 is above moderate levels	59	N/A	< 60
% Residents who rate City image as "High" or "Very High"	28%	N/A	50%
Average miles of Hike/Bike Trails per 1000	0.1	N/A	1.5
% households within ½ mile of bike/walk trails	~30%	N/A	50%

Figure 40. Indicator Table